PHASE II PART A

TASK 1.2.7A

SYSTEMS INTERIM STATUS REPORTS

METRO RAIL TRANSIT CONSULTANTS
DMJM / PBQD / KE / HWA

June 29, 1989

Mr. James E. Crawley, P.E.
Director of Transit Facilities
Transit Systems Development
Southern California Rapid Transit District
425 South Main Street
Los Angeles, CA 90014

Subject: Metro Rail Project
Completion of Phase II, Part A

Purpose: Information Transmittal

File No: P001G082

Dear Mr. Crawley:

The Phase II Interim Status Reports enclosed with this letter comprise the deliverable work products required by the Phase II, Part A Scope of Services for the MRTC Systems Division. These deliverables fulfill the requirements of Tasks Number 1.F and 1.G of the District's Authorization To Proceed letter Number 88-06545, December 21, 1988.

Complete Statements of Tasks required and Tasks performed are contained in the enclosures representing work accomplished by our Train Control, Traction Power, Communications, Operations and Maintenance, and Safety Assurance and Security disciplines. There were no major equipment deliverables scheduled to be completed during the Part A, preliminary design period. Part A work was extended from April 28, 1989 to June 30, 1989 (by District direction) and the systems tasks were completed within the Part A systems budget.

Work will be resumed on the Systems Division Tasks in accordance with the previously negotiated Scope of Services when District authorization is received.

Should additional copies of the submittals be required, we will be pleased to respond.

METRO RAIL TRANSIT CONSULTANTS

K.N. Murthy
Project Director

Encl: Phase II Interim Status Reports
Automatic Train Control (4)
Traction Power (4)
Communications (4)
Operations and Maintenance (4)
Safety/Assurance and Security (4)
Systemwide Equipment Procurement Study (4)

cc: W. Rhine, SCRTD
J. Sandberg, SCRTD
H. Storey, SCRTD
TSD-DCC
DCC (2)

PHASE II INTERIM STATUS REPORT
AUTOMATIC TRAIN CONTROL
JUNE 30, 1989

This report summarizes work completed for Automatic Train Control System during the period ending with the cessation of work on June 30, 1989.

The following excerpts from the Phase II Work Program describe the Automatic Train Control work tasks assigned and the work accomplished to an interim level during the period ending June 30, 1989:

- Establish power, grounding and equipment mounting space requirements on the wayside as well as in the ATC and Communications room and verify incorporation into MOS-2 facilities design planning.
- Refine and analyze block designs for combined MOS-1 and MOS-2 six car train operation at minimum headway taking into consideration operations in subway and on elevated guideway. Prepare analysis report utilizing ATC Block Design Computer Program.
- Refine design requirements for MOS-2 interlocking, including diamond cross-overs, pocket tracks, turnouts and turn back at terminal stations based on selected MOS-2 configuration. Incorporate requirements in prelimi-nary specifications.

The work program, which began in January 1989, called for work products to be developed on the following schedule:

Production	Completion Scheduled
Alignment & Operating Parameters	March 17, 1989
Interim Status Report	April 28, 1989
Draft Report (Part B Task)	July 28, 1989
Final Report (Part B Task)	Sept. 29, 1989

Initially the cessation of Phase II design work was scheduled to occur on April 28, 1989, so that the product at that interim period would have been the Interim Status Report. Phase II Part A work was rescheduled from April 28 to June 30 by RTD concurrence and direction.

Summary of Work Completed.

1. Work originated by Systems.

   - Worked with the Civil Engineers and Operations/ Maintenance Planners in the preparation of an interim status report on Phase II alignment and operating parameters. (Copy Attached)
   - Provided support in the preparation of the systemwide equipment procurement study.
   - Prepared approximate equipment lists, quantities, and space requirements in providing support for preparation of the Phase II cost estimates.

2. Review of design products originated by others.

   Reviewed preliminary facilities designs (MacArthur Park interlocking, Wilshire/Vermont, Vermont/Beverly, Vermont/Sunset, Hollywood/Vine, and B330) to verify, to the extent practicable, that existing standards and requirements for ATC are being incorporated; also the reviews provided some insight for defining the issues that must be addressed as the Phase II work progresses. The ensuing activities and definitions from the reviews are as follows:

   - Verified that the MOS-1 criteria regarding ATC equipment space, power, and conduit provisioning requirements are applicable to Phase II.
   - Identified the criteria for locating and sizing additional train control rooms (other than at stations) to accommodate the full-pocket interlockings and long station-to-station distances; investigated the restraints and other factors for determining and optimizing the locations.
   - Identified possible impacts to block design resulting from characteristics of the preliminary alignment; the effects of curves and grades on operations, headway, and run time must be closely monitored when Phase II design resumes.
   - Identified signaling alternatives for the Phase II interlockings; alternatives regarding automatic routing, terminal operation, pocket track operations, call-on, train storing, back-up routing, converge/diverge operations, station stopping, location of block boundaries, and signal approaches must all be addressed when Phase II ATC design begins.

- Determined which stations may be approached as "typical" with regard to ATC requirements in facilities design.

ANALYSIS OF PHASE II
ALIGNMENT & OPERATING PARAMETERS
INTERIM STATUS REPORT
JUNE 30, 1989

SUMMARY

This report describes work accomplished in response to the Metro Rail, Phase II, Part A task entitled Automatic Train Control Block Design Analysis. The description includes a brief report on the status of design work, as of the cessation of work on Phase II work tasks, on June 30, 1989, and comments on remaining work to be done after Phase II design resumes. The ATC Block Design Analysis is a necessary task in preparation for Phase II block design to be accomplished, and thus is a necessary step in the preparation of ATC furnish and install contract documents.

The work program description of the ATC Block Design Analysis task is:

> Refine and analyze block designs for combined MOS-1 and MOS-2 six car train operation at minimum headway taking into consideration operations in subway and on elevated guideway. Prepare analysis report utilizing ATC Block Design Computer Program.

The work program calls for four products:

1. Alignment & Operating Parameters
2. Interim Status Report
3. Draft Report (Part B Task)
4. Final Report (Part B Task)

Product 1 consisted of working notes used in the preparation of this report. Work on product 3, the draft report, will begin when Phase II design resumes.

This report is formatted with respect to geographical portions of the route, starting at the MOS-1 boundary at Alvarado Street.

MACARTHUR PARK POCKET TRACK

1. The addition of a full-pocket interlocking at this location imposes the requirement for an additional train control room. Several decisions must be made concerning options for emergency operation from a local control panel, maintainer needs, and SCADA interface. For preliminary design the control rooms will be treated as two separate locations.

2. Preliminary operating and block design criteria require trains to operate at 45 mph between Wilshire/Alvarado and Wilshire/Vermont, A5 and A6. Except for turnout moves, civil speed restrictions in this area should not be less than 45 mph.

3. Criteria concerning control and operation of the pocket interlocking must be established. The options of automatic routing, pushbutton back-up routing, call-on routing, and SCADA automatic routing will be considered. Alternatives will be analyzed and selected to fit SCRTD needs as appropriate during the design phase.

4. Distance to the A6 TC&C room is approximately 5,100 ft., which is within design limits.

5. Normal train speed from A5 to A6 will be 45 mph due to curves starting at approximately 292 and 303.

6. Trains traveling from A6 to A5 will be restricted to 45 mph for the early part of the trip; however, once the rear of the train clears the curve at (approximately) 292, it can be commanded to accelerate to 55 mph. The 55 mph command will be given, if the R=2500 curve (at approximately 278) can be designed with at least one inch of superelevation (to allow a 55 mph curve rating) without interfering with the special trackwork.

7. Block design specifications will be supplemented to address system characteristics introduced to Metro Rail in the MOS-2 alignment. In order to optimize operation with a full-pocket interlocking, requirements addressing the approaches to the wayside signals should be added. The signals that control both normal traffic movements, and diverging moves into the pocket track, should have an associated approach block of length consistent with a train approaching with a 9 mph speed command.

8. Where a station platform track constitutes all or part of the approach distance to a wayside signal, train moves into the station with the signal at STOP may have to be made in Restricted Manual Mode; manual berthing must be performed if the ATP subsystem does not permit the train to completely berth while operating in the ATO programmed station stopping profile. If manual berthing is required, preferred operation is to stop the train outside the platform, and then proceed to complete berth in manual mode. At A5 both station platforms are bounded by wayside signals; each scenario must be investigated to determine where manual berthing should be implemented.

9. Specific directive drawing(s) or marked up civil drawings will be needed for locating conduits and wayside equipment.

WILSHIRE/VERMONT (A6)

1. This is a diverge/converge interlocking. It is the only one in the Metro Rail System to date. Specific directive drawing(s) or marked-up civil drawings will be needed for locating conduits and wayside equipment.

2. Due to curves, maximum train speed between A6 and Wilshire/Normandie (B1) will be 45 mph for both tracks in both directions. Maximum speed for trains traveling from A7 to A6 will be 45 mph due to curve. Trains traveling from A6 to A7 could be given a 55 mph command when the rear of the train vacates the curve at 341; however, given that the distance required to accelerate from 45 mph to 55 mph is entirely 3.75% upgrade, it may be of questionable benefit in shortening runtime.

3. Design headway beyond the diverge/converge points will be 120 seconds per SCRTD acceptance of this feature as a cost reduction in the budget estimate. This applies to the normal direction station-to-station runs from A7 to A6 and B1 to A6 for following trains in the same traffic pattern.

4. Operation of the AL track interlocking (normally-converging) should have approach cleared automatic routing. The automatic routes will be cleared on a first-come, first-requested basis, and alternating routing if both approach zones are occupied.

   The block design specifications should require that a block boundary be located the distance in approach to each wayside signal corresponding to a 9 mph SBD, and that additional blocks shall be provided as necessary to attain the optimum intermediate speed approach to a signal at STOP.

5. Operation of the AR track interlocking (normally diverging) should not have automatic routing. RCC is provided train destinations, and can route automatically or manually. To continue operations in the event of RCC or CTS failure, a wayside pushbutton for routing should be provided. It may not be advantageous to require the train to close within 9 mph SBD of the red signal, since this would leave the train only partially within the platform. Options for operation are:

   a. Locate block boundaries and transmit speed commands such that trains will stop outside of the station platform. If the delay in waiting for the signal to clear is significant, RCC can authorize stop-and-proceed movement into the station.

b. The platform definition track circuit can be used as a zero speed block. This will allow the train in ATO to stop part-way in the station, and then berth manually in stop-and-proceed submode of MTO.

6. The approximate distances to adjacent TC&C rooms is 4,700 ft. to B1, and 5,700 ft. to A7; this is satisfactory.

WILSHRIE/NORMANDIE (B1)

1. Train speeds between this station and Wilshire/Western (B2) will not exceed 45 mph due to short distance.

2. The distance to the B2 TC&C room is approximately 2,200 ft. This short distance could allow deletion of this train control location. The distance is short enough that ATC would not require an equipment room; however, minimal cost savings would be realized since an equipment room for communications and ATC interface equipment (PSS and door control equipment) would be needed. Also, maintenance becomes easier as the distance between the ATC room equipment the wayside equipment becomes less.

3. B1 is a typical non-interlocking station; a common directive drawing for all non-interlocking stations is sufficient to illustrate ATC conduit and cableway needs.

WILSHIRE/WESTERN (B2)

1. This will be a temporary terminal location with diamond interlocking. Operation and design principles will be very similar to those of Wilshire/Alvarado for MOS-1. If a tail track can be included behind the station, runtime can be improved 25 seconds or more.

2. If the above-referenced tail track cannot be incorporated, then the use of trip stops, similar to A5 MOS-1 configuration, can permit the transmission of adequate speed commands on approach and into the platform for ATO operation, without requiring a long overrun track behind the platform.

3. A directive drawing should be developed to define the conduit requirements for this diamond interlocking; it may serve as a general directive for other diamond interlockings.

4. For BR Track block design specifications should require an approach block corresponding to 9 mph SBD, and best intermediate speed command approach to a signal at STOP.

VERMONT/BEVERLY (A7)

1. This diamond Interlocking is typical with no automatic routing.

2. Maximum train speed on both tracks and in both directions between A7 and A8 will be 55 mph.

3. Distance to the A8 TC&C room is approximately 4,700 ft., which is easily within limits.

4. A typical directive drawing for diamond interlocking locations should be sufficient to show conduit requirements.

5. Block design rules for approach to a signal at STOP through the platform track should be consistent with A5.

6. For AR track block design rules should allow 9 mph SBD approach to signal at STOP from the A6 direction.

VERMONT/SANTA MONICA (A8)

1. This is a typical non-interlocking station. Typical directive drawing will be sufficient to convey ATC conduit requirements.

2. Distance to A9 TC&C room is approximately 2,800 ft., which is substantially within limits; this indicates that only about 6 track circuits total will be required at this TC&C room location.

3. Maximum train speed on both tracks and in both directions between A8 and A9 will probably be 45 mph. Acceleration above the 45 mph speed regulation point would be possible; however, only a very minimal runtime savings on the A8 to A9 route would be achieved, since accelerating on a 4% upgrade would limit the time at higher velocity. Increased braking distance and slowing to 45 mph for a station stop would limit the speed in the A9 to A8 direction.

VERMONT/SUNSET (A9)

1. This is a typical diamond interlocking. A typical directive drawing developed for A7 should suffice for defining conduit needs.

2. The distance to the A10 TC&C room is approximately 5,800 ft.; this presents no problem.

3. Maximum train speed from station A10 to A9 will be restricted to 55 mph because of curve.

4. Maximum train speed from A9 towards A10 could be accelerated beyond 55 mph after curve, although runtime savings would be minimal.

HOLLYWOOD/WESTERN (A10)

1. This is a typical non-interlocking station. A typical directive drawing for conduit should suffice.

2. Distance to A11 station is about 5,100 ft. which is easily within the limits.

3. Maximum train speed from A11 to A10 would be 55 mph. There are no curve restrictions to limit to this speed; however, this is due to the short distance, and because part of the acceleration distance is on a 2% upgrade.

4. Maximum train speed from A10 to A11 could be above 55 mph; acceleration is assisted by 2% downgrade in the area where the limit is 45 mph or above. Actual runtime savings would be a nominal 4 seconds (very approximate).

HOLLYWOOD/VINE (A11)

1. This is a pocket track interlocking location and will need a specific directive drawing to show the conduit and cableway requirements.

2. Distance to A12 TC&C room is approximately 4,200 ft.

3. Operation of the pocket track should be consistent with Wilshire/Alvarado pocket, unless specific requirements of the SCRTD warrant deviation.

4. Maximum train speed on both tracks and in both directions between A11 and station A12 will be 55 mph.

HOLLYWOOD/HIGHLAND (A12)

1. This is a typical non-interlocking station. A typical directive drawing for conduit requirements will be sufficient.

2. Long distance to A13 station (approximately 16,800 ft.) will require TC&C rooms at the vent shafts at 653 and 709. Cable lengths would be excessive without the additional rooms.

3. Curve at west end of A12, and before the crossover at Universal City (A13), will limit speed slightly for trains

in both directions. However, much of the distance can be traveled at 67 mph.

UNIVERSAL CITY (A13)

1. This is a diamond interlocking, temporary terminal station. A typical directive drawing developed for other diamond interlocking locations should be sufficient for defining the conduit needs.

2. This location could be a temporary terminal for long duration. If so, 320 ft. minimum of tail track should be provided behind the station. This would be sufficient to store a 4 car train. And also, would make a significant runtime differential of 25 seconds or more for each train.

3. Block design specifications should require train to approach signal at STOP to within 9 mph SBD in normal direction.

PHASE II INTERIM STATUS REPORT
TRACTION POWER
JUNE 30, 1989

Introduction

This report summarizes Phase II traction power design work accomplished during the work program period ending June 30, 1989 and describes the interim status of the products of that work at the time of the end of the work program.

Scope of Work

The following traction power design activities were assigned under task 1.2.7.A of the Contract Scope:

1. Special studies were planned in two main areas of traction power design:

   a. Emergency Backup Power Analysis - Establish the emergency backup power requirements for the Phase II alignment taking into account critical load demands for systems and facilities equipment.

      This study is needed to determine a feasible and cost effective means of powering methane gas ventilation fans in the event of failure of the primary and alternative power supplies from the power utility. Five milestones were planned:

      (1) Phase II Power Requirements
      (2) Examine DWP Alternatives
      (3) Interim Status Report
      (4) Draft Report (Part B Task)
      (5) Final Report (Part B Task)

   b. Traction Power Transit Operating Model Analysis - Perform computer simulation runs (TOM runs) to establish power requirements and refine substation locations and capacity ratings for Phase II alignment.

      The purpose of the analysis is to identify the potential number, location, and power capacities of traction power substations for the selected candidate route alignment and profile of Phase II. Four milestones were planned:

      (1) Alignment & Operating Parameters
      (2) Part A Interim Status Report
      (3) Draft Report (Part B Task)
      (4) Final Report (Part B Task)

2. Systems engineering Traction Power support activities were assigned in three areas:

a. High voltage supply and distribution -- Prepare preliminary design for distribution of D.C. power and installation of 34.5 KV feeders for tunnels and stations.

b. Support of designs for traction power substations and electric power utility service facilities -- Define electric substation and utility entrance minimum sizes and coordinate incorporation of equipment room requirements into facility design planning.

c. Support of designs for electric power for passenger station and tunnel facilities including emergency ventilation equipment -- Review facility electric power loads for stations and vent shafts to establish required ratings of auxiliary power transformers.

Work Accomplished and Work Products

1. Special Studies:

a. The design of the emergency backup power supply (EBPS) system for Phase II was advanced to the "Examine DWP Alternatives" stage, but the milestone was not completed. It is recognized however, that power requirements for facilities essential to prolonged operation, in case of an event that would cause loss of primary and secondary utility power, can be directly extrapolated from the MOS-1 EBPS requirements, since both route portions are in subway, and there are no long interstation tunnel segments until the alignment north of the Hollywood Boulevard corridor needs to be considered. (Issues related to both normal and emergency power supply are yet to be addressed with regard to the tunnels through the mountains.)

Regarding EBPS design for the Wilshire and Vermont corridors, we will need to assess, more accurately than we have to date, the distance beyond which 34.5 KV voltage drop from the feed point in the MOS-1 yard becomes excessive. When Phase II design resumes, we will need to address designs considerations similar to those we addressed, with the District engineering staff, for the conceptual design of the MOS-1 EBPS.

b. A transit operation model (TOM) analysis of traction power requirements was carried out for the Phase II alignment identified as candidate alignment No. 1 modified (CA1M) based on extrapolation from results of a TOM analysis of the original starter line.

The analysis indicated that the rectifier rating selected as the standard size for MOS-1 traction power substation (TPSS) is suitable for Phase II, and that by the "design year" (2000), double rectifier/transformer units will be needed at each Phase II TPSS.

Because the extrapolation method yields conservative results, a more exacting analysis will be performed when Phase II design work resumes, to see if single rectifier/transformers can adequately serve some TPSS locations for a significant initial operating time. A copy of the revised report is attached.

2. Support Activities:

   a. TPSS equipment room space, access and conduit requirements were given to facilities designers.

   b. High voltage supply and distribution designs were advanced to a preliminary level that enabled us to provide to passenger station designers requirements for electric power incoming service facilities, conduits, blockouts, and equipment entrance ways.

   c. Space requirements were coordinated with the facilities design group for the incoming service (DWP) and traction power substation rooms at Wilshire/Vermont, Vermont/Beverly, Vermont/Santa Monica, Hollywood/Highland, and Universal City passenger stations. Preliminary equipment layouts were performed for these rooms to confirm that the planned room configurations and allocated spaces are adequate.

   d. Facilities drawings for construction contracts B331 and B201 were marked up to identify traction power requirements including traction power conduits and other embedments as well as interfaces at panelboards, junction boxes, etc.

   e. Preliminary contact rail designs were performed for Wilshire/Vermont "Y" and MacArthur Park pocket track structure to coordinate conduit stubups and walkway locations.

   f. Design support service inputs were provided for cost estimating, scheduling, and equipment descriptions as required for development of budgets, project schedules, and contract unit descriptions.

   g. Facilities design packages were reviewed and commented on, and responses to the comments were coordinated.

   h. Support was provided for the systemwide equipment procurement study.

METRO RAIL PROJECT
MOS-2, LPE

TRACTION POWER SUBSTATIONS LOCATIONS AND EQUIPMENT SIZES REPORT FOR CA1M

Prepared for
Southern California Rapid Transit District

by

Metro Rail Transit Consultants

February 1989

The preparation of this document has been financed in part through a grant from the U.S. Department of Transportation, Urban Mass Transportation Administration, under the Urban Mass Transportation Act of 1964, as amended, the State of California, and the Los Angeles County Transportation Commission.

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I. EXECUTIVE SUMMARY

This report identifies the potential number and locations of traction power substations for the selected Candidate Alignment No. 1 Modified (CA1M) as shown on Figure 1. The report also evaluates the equipment sizes (ratings) necessary to meet the Design Year and Long-Range Design Standard (LRDS) operating requirements for the combined MOS-1 and MOS-2 segments as defined by DD-002[1].

The methodology used to determine the spacing, locations, and rating of substations for CA1M consists of the following analytical procedures:

- The minimum acceptable voltage at trains to provide the necessary performance for the required peak period service headway establishes the average distance between, and optimum location of, the substations.
- Train size and service headway during peak period operation establishes the maximum load for which the traction power system should be designed.
- The maximum load on each substation is established from the first and second procedures.
- The required equipment continuous rating at each substation is derived from the load established by the third procedure.

These procedures have established preliminary locations and equipment ratings for CA1M which are shown in Table 1. These findings are to be confirmed by a detailed system analysis during preliminary engineering and final design phases of the project.

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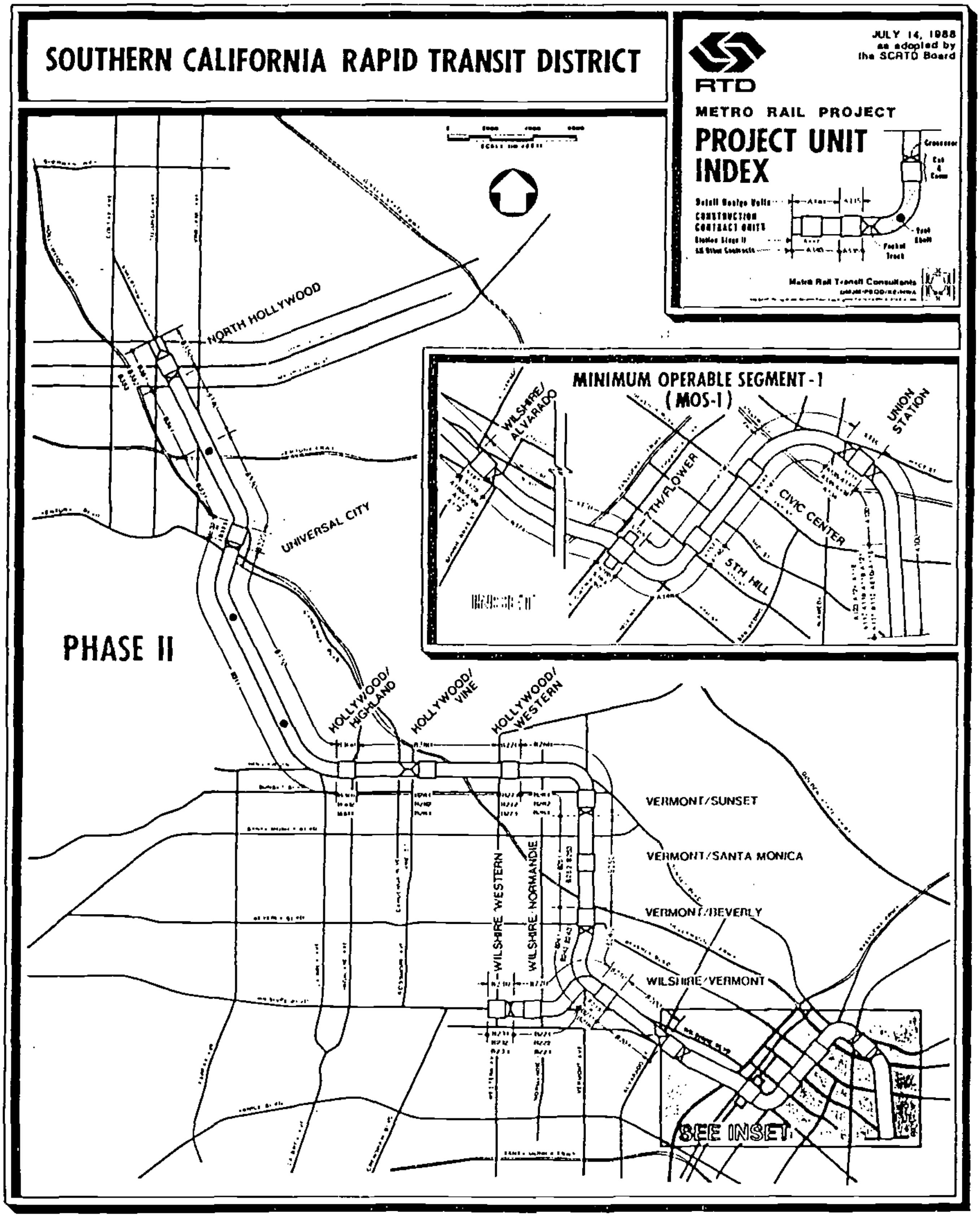
[1] Design Directive, Accommodation of Patronage Growth, Metro Rail Project, Long-Range Design Standard.



CANDIDATE ALIGNMENT NO. 1 MODIFIED (CA1M)

Figure 1

TABLE 1

CA1M

Substation Locations and Power Rectifier Ratings

Substation Locations	Rectifier Rating (kW) Design Year*	LRDS**
Wilshire/Vermont	2 X 2,500	2 X 2,500
Wilshire/Western	2 X 2,500	2 x 2,500
Vermont/Beverly	2 X 2,500	2 x 2,500
Vermont/Sunset	2 X 2,500	2 x 2,500
Hollywood/Western	2 X 2,500	2 x 2,500
Hollywood/Vine	2 X 2,500	2 x 2,500
Hollywood/Highland	2 X 2,500	2 x 2,500
Vent Shaft	2 X 2,500	2 x 2,500
Universal City	2 X 2,500	2 x 2,500
North Hollywood	2 X 2,500	2 x 2,500

* Six-car trains at 6-minute headway over branches and 3-minute headway over common alignment

** Six-car trains at 3-minute headway over branches and 2-minute headway over common alignment

II. BACKGROUND

This report provides the results of the study performed under Limited Preliminary Engineering for the selected Locally Preferred Alignment (LPA), identified as CA1M. The study covers a preliminary evaluation of traction power substation locations for this alignment, the load on each substation, and the proposed dc equipment ratings. The evaluation covers the requirements for train service over the combined MOS-1 and LPA segments, for the Design Year, and Long-Range Design Standard (LRDS) as defined by Design Directive DD-002.

III. CRITERIA AND METHODOLOGY

The determination of substation locations and capacities is based on the Metro Rail Project System Criteria for traction power and on the methodology used in a previous study [1] performed for the original starter line between Union and North Hollywood stations. The evaluation of substation spacing for each candidate alignment is based on the established vehicle performance characteristics, corrosion control requirements, and existing traction power wayside distribution parameters.

The evaluation of the traction power system total capacity and individual substation ratings is based on extrapolation from the results of a study performed by transit operation model (TOM) analysis of the original starter line.[1]

The evaluation of substation equipment sizing (rectifier and dc switchgear ratings) is based on the maximum load demand during peak period service operation and recognized standard ratings for this class of equipment.

IV. CA1M PARAMETERS

The alignment used for the study is shown diagramatically on Figure 2 and identified as CA1M. It extends from Wilshire/ Alvarado Station to the LPA terminal stations identified as Wilshire/Western and North Hollywood.

The operating parameters used in performing the study are based on those given in the SEIS/SEIR [2] and DD-002, and are described as follows:

---

[1] Report WBSZ-72-G12, Traction Power System Study, July 1985.

[2] Draft Supplemental Environmental Impact Statement/ Subsequent Environmental Impact Report, Los Angeles Rail Rapid Transit Project, Metro Rail, November 1987.

- The traction power system design is based on the maximum number of cars per train and shortest headway to be used during peak period service.
- At the Design Year, six-car trains will operate at a headway of 6-minutes over the two branches and at a headway of 3-minutes over the common alignment between Wilshire/Vermont and Union stations.
- For the LRDS, six-car trains will operate at a headway of 3-minutes over the two branches, and at a headway of 2-minutes over the common alignment.

V. TRACTION POWER SUBSTATION LOCATIONS

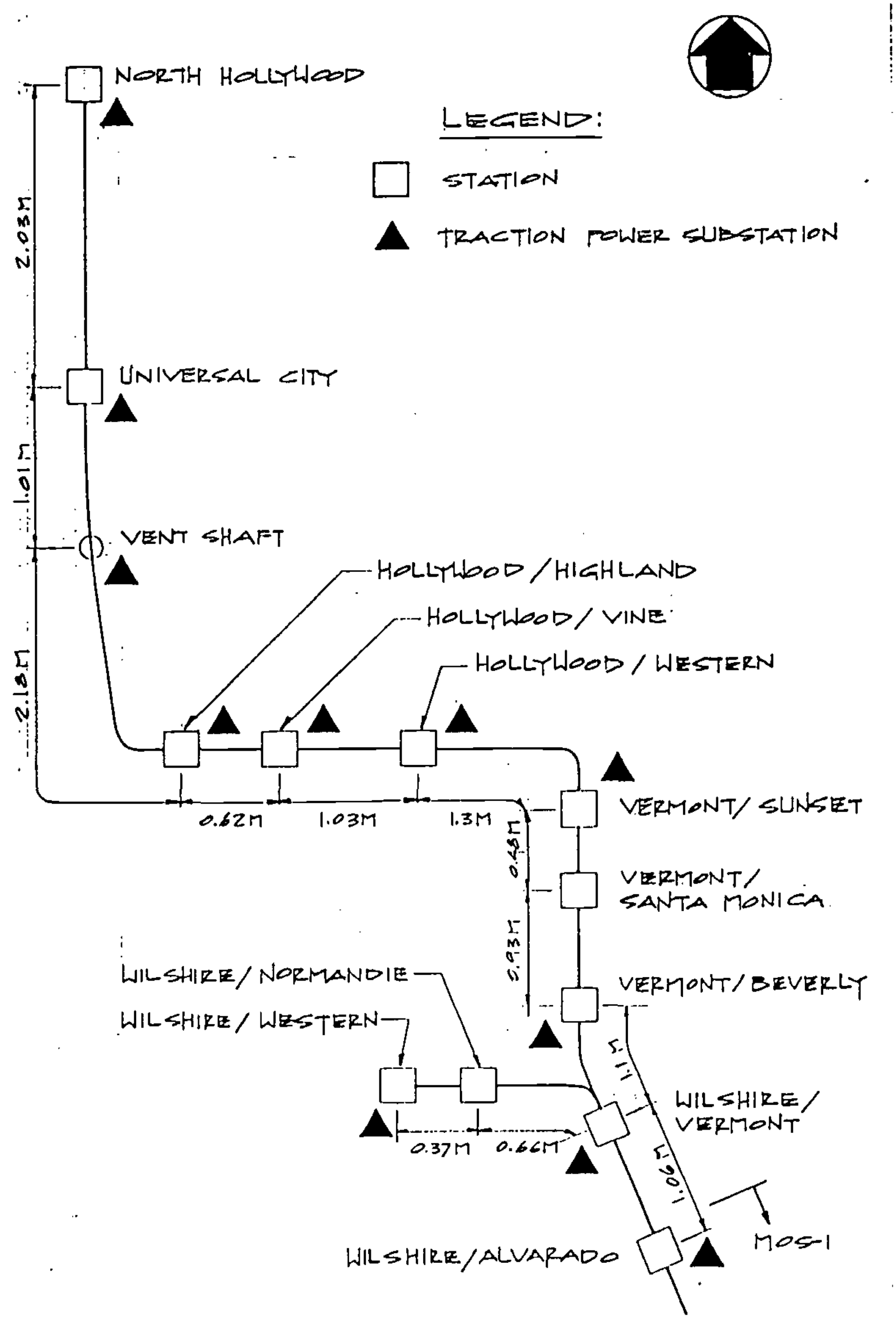
Previous traction power and corrosion control studies performed for the Metro Rail Project have confirmed that for a 750-V dc traction power system, substations should be located at stations, and with an average spacing between substations of one mile. These factors ensure that an average voltage of not less than 650 V is maintained at the vehicle power pick-up shoes during peak period service with all substations in operation. The proposed locations and estimated distances between traction power substations for CA1M are shown on Figure 2.

VI. TRACTION POWER SYSTEM LOAD

The evaluation of load on the LPA segment traction power system is based on peak period service requirements, the stated criteria and methodology, and extrapolation of the data obtained from the previous study for the original starter line. Load calculations are attached as Appendix A.

A. Peak Period Service Load

The previous study1 performed on the original starter line established the traction power load during peak period service. A TOM program simulation was made for six-car trains operating at 2-1/2-minute headways over a distance of 17.87 miles between the Union and North Hollywood terminal stations. The peak period load on the traction power system was established as being in the order of 72,000 kW. This data is derived from Table 3-3A of that study, which is included in Appendix B. The original traction power system incorporated 16 substations, spaced apart at distances varying between 0.6085 and 2.4256 miles.



LPA CA1M
TRACTION POWER SUBSTATION LOCATIONS

Figure 2

The average load demand on each substation varied between 3,700 kW and 5,200 kW, with an average value of 4600 kW. The average load demand per mile of alignment was:

$$\frac{72,000}{17.87} = \underline{4063 \text{ kW}}$$

B. LPA Segment Peak Period Service Load

The preliminary evaluation of peak period service load on the LPA segment traction power system can be extrapolated from the data derived from the previous system study[1] by the following methodology:

- o The calculation of average load demand is based on the formulae used for the previous system study[1] to convert the output data from the TOM computer simulation program 7. These formulae are given in Appendix C.

- o The peak period LRDS load demand per mile on the original starter line traction power system, with six-car trains operating at 2-1/2-minute intervals, can be converted to an "equivalent value" average load per mile of alignment for a single car by means of the referenced formulae. This value of load is used as the basis for establishing the load on the traction power system for the LPA segment.

- o The CA1M alignment between Wilshire/Alvarado and the Wilshire/Western and North Hollywood stations comprises approximately 12.82 miles of double-track mainline, with 11 passenger stations and 10 traction power substations. The traction power system capacity is based on peak period service over the two branches.

C. Design Year Service Load

- o At the Design Year, peak period service will be performed by six-car trains operating at headways of 3-minutes over the trunk line and 6-minutes over the two branch lines.

- o The traction power system load was calculated from the "equivalent value" and established as 7,184 kW for the trunk line and 28,615 kW for the two branch lines.

- The average substation load demands are 3,036 kW for trunk substations and 3,179 kW for branch substations.

D. LRDS Service Loads

- The LRDS peak period service will be performed by six-car trains operating at headways of 2-minutes over the trunk line and 3-minutes over the two branch lines.
- The traction power system loads calculated from the "equivalent value" were 8,798 kW for the trunk line and 40,474 kW for the two branch lines.
- The average substation load demands are 4,399 kW for trunk substations and 4,497 kW for branch substations.

VII. LPA SEGMENT TRACTION POWER SUBSTATION EQUIPMENT CAPACITY

The major items of substation equipment, whose capacity is dependent on the load for peak period train operation, are the transformer/rectifier units and dc switchgear. Based on established criteria[1] for traction power system design, all substations shall have provision for two transformer/rectifer units of equal capacity to meet the full system LRDS service load demand and provide partial redundancy.

Each transformer/rectifier unit will have a two-hour overload capability of 163 percent of its continuous rating. This overload capability can be used to meet the peak period service load and abnormal loading conditions caused by a substation outage. This overload capability is not normally used, however, for the evaluation of transformer/rectifier rating for peak period load under normal operating conditions because of the reduction of dc voltage level at the substation bus.

The dc switchgear ratings are based on the overload capability of the selected transformer/rectifier units and on the load imposed by trains operating on each segment of railtrack supplied from the substation.

A. Rectifier Transformer Capacity

- Based on the average load per mile of track, two 2,500 kW transformer rectifier units will have to be installed at all trunk and branch line substations in order to satisfy the peak period service for the Design Year.

- The two 2,500 kW transformer rectifier units will also support the LRDS peak period service.

B. <u>750-V Dc Switchgear Rating</u>

- The switchgear bus and transformer/rectifier unit cathode circuit breaker continuous current rating will match the rectifier two-hour overload rating as follows:

  - 2,500 kW transformer/rectifier unit 2-hour overload rating = 2,500 x 1.63 = 4,075 kW

  Therefore: Main bus and cathode circuit breaker rating will be not less than:

$$\frac{4075 \times 10^3}{750} = \underline{5433\text{ A}}$$

- Feeder circuit breaker current rating will be based on the LRDS service load, with 6-car trains operating at 2-minute headways. From the previous sytem study[1] performed for LRDS service, it was established that the required continuous current rating of the 750V dc feeder circuit breakers was <u>4,000 A</u>.

END OF REPORT

APPENDIX A

METRO RAIL TRANSIT CONSULTANTS
DMJM / PBQD / KE / HWA

LOS ANGELES METRO RAIL PROJECT	JOB No. MOS-2 LPE	SHEET No. 1 of 3
MOS-2 SEGMENT LPA	DESIGNED BY GWP	DATE 8/21/88
TRACTION POWER SYSTEM CALCULATIONS	APPROVED	

CALCULATION OF AVERAGE KW LOAD PER TRAIN

A. BASIS FOR CALCULATION:

- AVERAGE LOAD PER TRAIN (kW)

$$= N \times \sqrt{\frac{3600}{HDWY}} \times \frac{1}{2} \times \left[\frac{\sqrt{A+B} + \sqrt{C}}{2} \right] \times V$$

$$= N \times \sqrt{\frac{3600}{HDWY}} \times (\text{CONSTANT } K)$$

WHERE:

N = NUMBER OF CARS PER TRAIN

HDWY = HEADWAY IN SECONDS

V = DC VOLTAGE AT SUBSTATION BUS

A = AVE. (ASQ-H)

B = MIN. (ASQ-H)

C = MAX. (ASQ-H)

o. PEAK LOAD ON ORIGINAL STARTER LINE FOR LRDS SERVICE — (REF. TABLE 3-3A OF JULY 1925 REPORT)

TOTAL LOAD ON TRACTION POWER SYSTEM (COLUMN 3) = 72600 kW

LENGTH OF STARTER LINE ROUTE ~ 17.87 MILES

$$\text{AVERAGE LOAD/MILE OF ROUTE} = \frac{72600}{17.87} = 4063 \text{ kW}$$

o EQUIVALENT LOAD OF ONE CAR/MILE OF ROUTE (kW_c)

FROM 6 CAR TRAINS AT 2-½ MINUTE HEADWAYS

$$\therefore kW_c = 4063 / 6 \times \sqrt{\frac{3600}{150}} = \frac{4063}{6 \times 4.9} = 138 \text{ kW}$$

Page 2 of 3 ☐
Made by DAN BRICOIANU
Date 2/10/89
Checked by
Date

B. PEAK LOAD/MILE ON LPA TRACTION POWER SYSTEM.

B1. DESIGN YEAR

- TRUNK LINE – 6 CAR TRAINS AT 3 MIN HEADWAYS

$$LD/M = 6 \times \sqrt{\frac{3600}{180}} \times 138^{*} = \underline{3703 \text{ kW/mile}}$$

- BRANCH LINES – 6 CAR TRAINS AT 6 MIN HEADWAYS

$$LD/M = 6 \times \sqrt{\frac{3600}{360}} \times 138 = \underline{2618 \text{ kW/MILE}}$$

B2. LRDS

- TRUNK LINE – 6 CAR TRAINS AT 2 MIN HEADWAYS

$$LD/M = 6 \times \sqrt{\frac{3600}{120}} \times 138 = \underline{4535 \text{ kW/MILE}}$$

- BRANCH LINES – 6 CAR TRAINS AT 3 MIN HEADWAYS

$$LD/M = 6 \times \sqrt{\frac{3600}{180'}} \times 138 = \underline{3703 \text{ kW/MILE}}$$

C. AVERAGE LOAD ON LPA TRACTION POWER SUBSTATIONS

(CAIM ROUTE LENGTH IS 12.87 MILES OUT OF WHICH 1.94 MILES ARE FED BY TWO "TRUNK" SUBSTATIONS AND 10.93 ARE FED BY 9 "BRANCH" SUBSTATIONS)

C1. DESIGN YEAR

- TRUNK LINE – 6 CAR TRAINS AT 3 MIN HEADWAYS

$$LD/S = 3703 \times 1.94/2 = \underline{3.036 \text{ kW}}$$

* EQUIVALENT LOAD/CAR kW_c = 138 kW

Page 3 of 3 ☐
Made by DAN BAICOIANU
Date 2/10/89
Checked by
Date

- BRANCH LINES – 6 CAR TRAINS AT 6 MIN HEADWAYS

LD/S = 2618 × 10.93/9 = 3179 kW

C2. LRDS

- TRUNK LINES – 6 CAR TRAINS AT 2 MIN HEADWAYS

LD/S = 4535 × 1.94/2 = 4399 kW

- BRANCH LINES – 6 CAR TRAINS AT 3 MIN HEADWAYS

LD/S = 3703 × 10.93/9 = 4497 kW

APPENDIX B

TABLE 3-3A

COMPLETE STARTER LINE CONFIGURATION (2-1/2-MIN HEADWAY)
NORMAL OPERATING CONDITION
SUBSTATION AVERAGE LOAD AND TRAIN VOLTAGE

Substation Location	Spacing (Miles)	Rectifier Rating (MW)	Average Load Demand (MW)	* Required Minimum Capacity (MW)	** Train Minimum Voltage
Union		2 x 2.5	3.1	2.1	
	0.8356				693
Civic Center		2 x 2.5	4.7	3.1	
	0.4595				711
5th/Hill		0	0	0	
	0.5473				669
7th/Flower		2 x 2.5	5.0	3.3	
	1.1178				699
Wilshire/Alvarado		2 x 2.5	4.7	3.1	
	1.0412				694
Wilshire/Vermont		2 x 2.5	5.1	3.4	
	0.5981				706
Wilshire/Normandie		0	0	0	
	0.4245				669
Wilshire/Western		2 x 2.5	5.1	3.4	
	0.6085				710
Wilshire/Crenshaw		2 x 2.5	4.6	3.1	
	1.4161				700
Wilshire/La Brea		2 x 2.5	4.7	3.1	
	0.9463				692
Wilshire/Fairfax		2 x 2.5	4.2	2.8	
	0.8341				708
Fairfax/Beverly		2 x 2.5	4.4	2.9	
	1.0654				703
Fairfax/S. Monica		2 x 2.5	4.7	3.1	
	1.3445				690
La Brea/Sunset		2 x 2.5	4.8	3.2	
	0.9922				693
Hollywood/Cahuenga		2 x 2.5	5.2	3.5	
	2.4356				648
Vent Shaft: Sta. 876+63		2 x 2.5	4.1	2.7	
	1.0125				689
Universal City		2 x 2.5	4.5	3.0	
	2.1885				676
North Hollywood		2 x 2.5	3.7	2.5	

* Average load demand divided by rectifier 2-hr overload capability of 150% rating.

** Minimum voltage at a train operating between adjacent stations.

APPENDIX C

FORMULAE FOR
SUBSTATION POWER CAPACITY CALCULATIONS

1. **Average RMS Current**

A. Average RMS I =
(Amperes/Vehicle)

$$\sqrt{\left[\text{Ave.}(\text{ASQ-H}) \times \frac{(3600)}{\text{HDWY}} + \text{min.}(\text{ASQ-H}) \times \frac{(3600)}{\text{HDWY}}\right]}$$

B. Maximum RMS I = $\sqrt{\left[\text{Max. }(\text{ASQ-H}) \times \frac{(3600)}{\text{HDWY}}\right]}$
(Amperes/Vehicle)

C. Average I = $6 \; \frac{(\text{Ave. RMS I} + \text{Max. RMSI})}{2}$
(Amperes/Train)

Where:

Ave. (ASQ-H) = Average Substation loading (Column 6 of TOM-7 Output)

Min. (ASQ-H) = Minimum Substation loading (Column 5 of TOM-7 Output)

Max. (ASQ-H) = Maximum Substation loading (Column 7 of TOM-7 Output)

HDWY = Train operating headway, seconds.

2. **Average Megawatts**

$$\text{Average MW} = \frac{\text{Ave. I} \times \text{Voltage at Substation Bus}}{10^6}$$

$$\text{2 Hr Loading} = \frac{\text{Ave. MW} \times \text{C}}{\text{Transformer - rectifier overload factor}}$$

Where: C = 1.2 for end stations
C = 1.1 for nonend stations
Transformer-rectifier overload factor = 1.5

PHASE II INTERIM STATUS REPORT
COMMUNICATIONS
JUNE 30, 1989

This report summarizes communications system design work for Phase II of the Metro Rail Transit system accomplished during the work program period ending June 30, 1989. The work tasks were assigned with the understanding that an interim report would be prepared at at the conclusion of Part A, after which the work might be interrupted for a period of a few weeks or months. Initially the interim report was scheduled for April 28, 1989; and was subsequently rescheduled for June 30, 1989, and as of that date all Phase II work was halted. This report briefly addresses tasks that will be resumed, using the work products that are in various stages of completion as of June 30, 1989.

Limited Preliminary Engineering (LPE) refers to a work program in which certain Phase II preliminary design work was done just prior to work summarized in this Interim Report.

Work Planned

Six areas of communications systems work were planned:

1. Preliminary Design Specifications

   The equipment specifications developed for MOS-1 will be reviewed for applicability and interface with Phase II procurements. The CUDs developed for Phase II will be refined as required. Development of preliminary specifications will be initiated after contract units are identified. Requirements for compatibility with MOS-1 equipment will be listed and an equipment interface listing will be established for each contract.

2. Radio, CCTV and PA Requirements

   Incorporate Limited Preliminary Engineering requirements for radio, CCTV, and PA into equipment concepts.

3. Emergency and Access Management

   Establish and refine emergency management, intrusion detection and access control system requirements for Phase II station and vent shafts and develop compatible design concepts for integration into MOS-1 voice and SCADA subsystem.

4. Seismic and Gas Detection

   Establish and incorporate Phase II seismic and gas detection requirements into preliminary specifications.

5. Redundancy Requirements

Analyze potential requirements of redundant communications during RCC down time.

6. SCADA Integration

Perform analysis of SCADA software and hardware modifications needed for addition of the Phase II system to existing MOS-1 equipment.

Work Not Anticipated

LAPD Radio Requirements

Additional design study became necessary to consider the Los Angeles Police Department radio requirements in the underground portion of the Metro Rail, and to evaluate the design, cost and operational consequences for Phase II.

Work Accomplished and Work Products

1. Preliminary Design Specifications

In the Phase II, Part A activities, work that was begun in the LPE activities was continued, especially in the reviews and analysis of MOS-1 communications designs, for direct or modified applicability into the Phase II designs. The review and analysis extended beyond the design specifications used for procurement of the MOS-1 Communications design, into the design documents submitted by the A640 Contractor. The Contractor's designs have advanced to the review portion of Preliminary Design cycle. Using the design information from these design reviews we have started to implement basic detail designs into the Phase II preliminary work. A systems procurement study has been initiated (discussed in a separate interim report), the results of which will affect the composition of design specifications for some or all of the Phase II Communications subsystems. Communications staff support was continuously required to assist in formulating the procurement study alternatives.

2. Radio, CCTV and PA Requirements

A preliminary radio frequency (RF) power budget was developed to assess the power needed for the radio subsystem. The RF power budget is being used to determine base station repeater locations. Early preliminary design of the Communications subsystems were performed to develop approximate equipment quantities, equipment room space requirements and order of magnitude cost estimates.

3. Emergency and Access Management

Conceptual designs were begun, based on review of MOS-1 requirement extrapolations.

The fire detection and suppression requirements have been reviewed by the Fire/Life Safety Committee. Several modifications can be made which may result in fewer monitoring devices, and potentially, some reductions in floor space, wiring, and indications. We are in the process of verifying these potential savings at this time.

4. Seismic and Gas Detection

We have begun estimating gas monitoring locations and analyzer units within each passenger station and tunnel section, based on the consideration that all of Phase II locations are classified as "gassy".

Contractor implementation of the MOS-1 gas monitoring equipment has revealed that the central analyzer units, with necessary peripheral equipment, require more TC&C room space than first considered, and that all the apparatus must be powered by UPS power. These factors must be considered in Phase II equipment.

5. Redundancy Requirements

Consideration has been given to studying means of providing a totally independent means of communicating from underground Metro Rail locations to the "outside world" in the event of a catastrophe that would knock out the normal and emergency communication routes that go through the RCC. No specific work has begun on that study.

6. SCADA Integration

No specific work has been done to integrate the MOS-1 SCADA system across the boundary between it and the Phase II facilities and systems that will be under centralized supervisory control form the RCC. When Phase II design resumes, the task will begin with the assessment of approximately how much parallel capability will be needed at the RCC.

Unanticipated Work Accomplished

LAPD Radio Requirements

The Los Angeles Police Department has requesting additional radio frequency capability to be installed in underground portions of Metro Rail system. The design of this radio system addition is still in its conceptual phase. Major impact on floor space in the TC&C rooms and the communications equipment rooms in the Rail Control Center is anticipated.

The LAPD radio requirements have not been entered into the RF power budget discussed under #2 above.

PHASE II INTERIM STATUS REPORT

Operations and Maintenance Planning
June 30, 1989

I. INTRODUCTION

The O&M discipline provides support to the O&M Committee for Phase II through participation at meetings and as a liaison with MRTC disciplines. Deliverables include a maintainability analysis report, and a maintenance equipment summary report. Due to work performed on the Hollywood Area Pocket Track Study, some work originally planned was deferred.

II. AWP REQUIREMENTS-PART "A"

The AWP requirements for Part "A" work include the following:

1. Maintainability analysis of line sections and structures report
2. Maintenance equipment summary report

III. ADDITIONAL WORK NOT ANTICIPATED

At the District's request, MRTC was directed to prepare an analysis to determine the optimum location for a pocket track along Hollywood Boulevard. Concerns expressed from the City of Los Angeles relating to potential negative construction impacts on the surrounding businesses have caused a re-examination of the current pocket track location on the west end of the Hollywood/Vine Station.

IV. SUMMARY OF WORK AND DELIVERABLES

1. The major work product of the O&M Staff for Part A was preparation of the pocket track study.

   Numerous working sessions were held with District representatives to discuss the operational, maintenance, business, construction, traffic and cost impacts related to locating the pocket track.

   The Hollywood area pocket track report was prepared in final draft form and distributed for SCRTD to prepare the conclusion and recommendation in April, 1989.

District input on the conclusion and recommendation section was received at MRTC the week of June 19. MRTC has issued the final report.

2. <u>Maintainability Analysis of Line and Structures</u>

The maintainability analysis of line sections and structures has been initiated. Work to date has been identifying various maintenance procedures (e.g. custodial room/closet location access, line sump pump pit clean-out) that can be more easily accommodated through minor design features. Facility design has not yet progressed to the point at allowing completion of the analysis.

Much of the work to date has focused on the discussions and coordination of issues with in-house architects and mechanical discipline staff.

3. <u>Maintenance Equipment Summary Report</u>

The maintenance equipment summary report will be prepared during Part B activities. Budget limitations precluded further Part A work.

V. REVIEW OF WORK BY OTHERS

The O&M discipline has been involved in the review and comment of the following Phase II contracts:

- Phase II Conceptual Design Review of station Contracts B240, B250, B270, B280, and B300
- B201 Line Section Alvarado to Vermont Station (In-Progress)
- B330 Line Section-Universal City to North Hollywood (In Progress)
- B331 Line Section-Universal City to North Hollywood (In-Progress)

PHASE II INTERIM STATUS REPORT

Safety, Assurance and Security
June 30, 1989

I. INTRODUCTION

This report encompasses the verification of emergency exiting capability of the following stations and the determination of the adequacy of the existing DWP water distribution system to supply the required flow/pressure to the fire suppression systems of the following station and line section contracts.

A. RED LINE STATIONS/LINE SECTIONS

1. Wilshire/Alvarado - Wilshire/Vermont Line Section, with Pocket Track (B201)
2. Wilshire/Vermont Station (B211/B215)
3. Wilshire/Vermont - Vermont/Beverly Line Section and Vermont/Beverly Station, with Crossover (B241)
4. Vermont/Beverly - Vermont/Sunset Line Section and Vermont/Santa Monica Station (B251)
5. Vermont/Sunset - Hollywood/Western Line Section and Vermont/Sunset Station, with Crossover (B261)
6. Hollywood/Western Station (B271)
7. Hollywood/Western - Hollywood/Highland Line Section and Hollywood/Vine Station, with Pocket Track (B281)
8. Hollywood/Highland Station (B301)
9. Universal City Station - Ventura Freeway Line Section, with Vent Structure (B331)

B. ORANGE LINE STATIONS/LINE SECTIONS

1. Wilshire/Vermont - Wilshire/Western Line Section and Wilshire/Normandie Station (B221)
2. Wilshire/Western Station, with Crossover and Tailtrack (B231)

II. ANNUAL WORK PLAN REQUIREMENTS - PART "A"

A. EMERGENCY EXITING

Review conceptual station designs to verify conformance to emergency exiting criteria requirements, using approved projected patronage data.

B. WATER SUPPLY ANALYSIS

Perform preliminary hydraulic calculations for station and line section fire suppression systems to determine flow/pressure demands. Review DWP Service Analysis Reports to verify adequacy of existing DWP water distribution system to meet required demands.

III. ADDITIONAL WORK THAT WAS NOT ANTICIPATED

A. MULTIPLE STATION ENTRANCE CONFIGURATIONS

Due to the complexity of Wilshire/Vermont Station siting considerations, multiple station layouts and entrance configurations were proposed by the architectural staff. Layouts of each proposal were reviewed to determine potential impact on emergency exiting times and travel distances.

B. DETERMINE CONCEPTUAL STAIR/ESCALATOR CAPACITY REQUIREMENTS

Using verbal information and generic sketches provided by architectural design staff, an order of magnitude number of required emergency exit lanes was determined for six (6) stations based on patronage data in D-001, Revision 1.

IV. SUMMARY OF WORK AND DELIVERABLES

A. WORK ORIGINATED BY SAFETY, ASSURANCE & SECURITY

1. Computer generated exiting calculations and letter reports were developed for seven (7) stations based on input provided by design staff. This information was submitted to design personnel. See Attachments A, A.1, B and C.

2. Through coordination with LAFD representatives, MRTC obtained a DWP Service Analysis Report (flow/ pressure report) for the proposed point of connection to the DWP water distribution system at the B331 vent structure.

3. Computer generated hydraulic calculations were developed for the B331 tunnel fire suppression system. Calculations were based on the wet standpipe system design depicted in the prefinal (85%) design review submittal. System flow/pressure demand was compared to existing DWP capability and a letter report was issued indicating compliance with criteria requirements. See Attachment D.

B. REVIEW OF WORK BY OTHERS

1. As a basis for performing preliminary emergency exiting calculations for the Wilshire/Vermont Stations, preliminary architectural drawings and sketches showing proposed station layout, platform plans, ancillary plans, and station longitudinal sections were reviewed. These drawings were provided by architectural personnel. Approximately three (3) different station layouts/entrance configurations were reviewed.

   Preliminary calculations for the remaining six (6) Red Line stations covered by this report were based on a verbal description of a generic station, provided by architectural staff. The Phase II final conceptual design drawings distributed for review in May 1989 were not of sufficient detail to perform emergency exiting calculations, therefore none were developed

   Projected patronage data used for all preliminary emergency exiting calculations performed for Phase II was that contained in DD-001, Revision 1.

2. As a basis for performing tunnel wet standpipe system hydraulic calculations for Contract B331, the mechanical drawings issued as a part of the prefinal (85%) design review submittal were reviewed. Additionally, the DWP Service Analysis Report obtained through LAFD was reviewed in determining the capability of the tunnel wet standpipe to perform as required.

   The design of utilities for the remaining Red Line stations/line sections covered by this report did not progress to a point sufficient to determine the proposed points of connection to the DWP water distribution system. Due to this fact, no work on the task of determining the adequacy of the existing water distribution system was performed.

IV. PLANS FOR FUTURE WORK

A. EMERGENCY EXITING

Preliminary emergency exiting calculations will be developed based on the final design 30% review submittal for the seven (7) Red Line stations covered by this report. Recommendations will be developed to address areas of non-compliance, if any, and to otherwise enhance station emergency exiting. Final emergency exiting calculations will be based on the final design 85% review submittals.

Upon resurrection of design activities for the two (2) Orange Line stations included in this report, the appropriate emergency exiting calculations previously developed and included in the September 1984 Metro Rail Project Station Exiting Calculations Report will be reviewed and refined to reflect revised patronage data from DD-001, Revision 1 and any proposed revisions to station configurations. Final emergency exiting calculations for these stations will be based on the final design 85% review submittals.

B. WATER SUPPLY

Once utilities design for the Red Line stations and line sections is developed to the degree that points of connection to the DWP water distribution system can be determined, DWP Service Analysis Reports for the appropriate locations will be requested through the project LAFD representatives. Station and line section vertical alignment and fire suppression system schematic drawings will be reviewed. Hydraulic calculations will be developed to determine flow/pressure demands at each proposed point of connection. These demands will be compared to the DWP system capability to determine compliance with criteria requirements. A final report will be issued based on the final design 60% review submittal.

89-02583

— ATTACHMENT A —

Rolf Jensen & Associates, Inc.
FIRE PROTECTION ENGINEERS • BUILDING CODE CONSULTANTS

RECEIVED
MAR 27 1989
D.C.C.

March 23, 1989

FAX
(213)622-4670

Mr. Malcolm Ingram
Metro Rail Transit Consultants
548 South Spring Street, Seventh Floor
Los Angeles, California 90013

WILSHIRE/VERMONT EXIT CALCULATIONS

Malcolm:

Enclosed are the preliminary exit calculations for the Wilshire/Vermont Station with the maximum egress times as follows:

Location of Discounted Escalator	Egress Time (minutes)
Lower Platform (.LPE)	4.929
Upper Platform (.UPE)	4.883
Concourse (.CE)	4.954

All egress times are under 6 minutes and comply with the Fire/Life Safety Criteria.

We have the following comments on the review of the drawings.

Drawing Number	Comment
SKA-12	Auxiliary Power & Battery Room and Air Supply Room have openings directly into the emergency exit passageway which are not permitted by Section 3312(a) of the UBC. A vestibule has been previously accepted as an alternate by the Fire/Life Safety Committee for other stations.

Please give me a call if you have questions.

Sincerely,

Christopher L. Vollman

Christopher L. Vollman, P.E.

CLV:jmp - H3275 Wilshire/Vermont

4949C

5252 Hollister Road • Houston, Texas 77040 • 713/462-1840 • FAX 462-0812

```
                  EMERGENCY EXITING CALCULATIONS        SHT 1 OF 4WILVERDY.LPE

STATION:  WILSHIRE /VERMONT      DATE: 3/22/89         BY:   EHS
NET PLATFOM AREA:   UPPER =       9010 LOWER =       12384
OCCUPANT LOAD CALCULATION                          DESIGN YR
 ----------------------
PEAK HOUR                                    A.M.                P.M.

LINK LOADS:          INBOUND                11420                4862
                     OUTBOUND                5662                9766

ENTRAINING LOADS:    INBOUND                 2863                1999
                     OUTBOUND                 806                1130

PEAK 15 MINUTE LOADS [=PEAK HR. LOAD x 1.15 / 4]
--------------------
LINK LOADS:          INBOUND                 3284                1398
                     OUTBOUND                1628                2808

ENTRAINING LOADS:    INBOUND                  824                 575
                     OUTBOUND                 232                 325

PEAK HEADWWY         INBOUND                  3.0                 3.0
                     OUTBOUND                 3.0                 3.0

CALCULATED TRAIN LOAD [=PEAK 15 MIN. LINK LOAD / (NO. OF HEADWAYS)]
--------------------- [NO. OF HEADWAYS =INTEGER(15 MIN. / HEADWAY)]
                                             A.M.                P.M.
                     INBOUND                  657                 280
                     OUTBOUND                 326                 562
          [USE NOT<1320]

PEAK ENTRAINING LOAD =[PEAK 15 MIN. LOAD x (4 x HEADWAY / 15 MIN.)]
--------------------                         A.M.                P.M.
                     INBOUND                  660                 460
                     OUTBOUND                 186                 260

TOTAL OCCUPANT LOAD [=CALCULATED TRAIN LOAD + PEAK ENTRAINING LOAD]
-------------------                          A.M.                P.M.
                     UPPER PLATFORM          1506                1580
                     LOWER PLATFORM          1980                1780

DENSITY [=NET PLATFORM AREA / PEAK ENTRAINING LOAD
-------                                      A.M.                P.M.
          [NOT < 4 SQ.FT. / PERSON]  UPR    48.44               34.65
                                     LWR    18.76               26.92

STATION OCCUPANT LOAD [=LOWER + UPPER]       3486                3360
---------------------

TOTAL OCCUPANT LOAD FOR CALCULATIONS         3486
```

```
                 EMERGENCY EXIT CAPACITY               SHT 2 OF 4WILVERDY.LPE
                 -----------------------
STATION:  WILSHIRE /VERMONT       DATE: 3/22/89        BY:    EHS

  IT LANES AND CAPACITY PROVIDED
 ----------------------------


ELEMENT   DIRECTION   NUMBER   x LANES   x CAPACITY    =        PPM
                                            / LANE
Lower Platform to Upper Platform                                        Upper Platform to Concourse
--------------------------------                                        ---------------------------
Stairs     -up            4         3          35      =        420     Stairs     -up            4         3          35        420
           -down          0         0          40      =          0                -down          0         0          40          0
Escalators-up *           3         2          35      =        210     Escalators-up             4         2          35        280
           -down          0         0          40      =          0                -down          0         0          40          0
Emer.      -up            4         4          35      =        560     Emer.      -up            2         2          35        140
Stairs     -down          0         0          40      =          0     Stairs     -down          0         0          40          0
* Discounted                                                   ----                                                       ----------
                                   34     Total                1190                                  24 Total                    840
Through Fare Barriers (South)                                           Through Fare Barriers (North)
-----------------------------                                           -----------------------------
Turnstiles                4         1          25      =        100     Turnstiles                4         1          25        100
Fare Gates                0         1          50      =          0     Fare Gates                0         1          50          0
Service Gates             1         2          50      =        100     Service Gates             1         2          50        100
Emergency Gates           2         2          50      =        200     Emergency Gates           2         2          50        200
                                                               ----                                                       ----------
                                          Total                 400                                         Total                400
Fare Barriers to Safe Area (South)                                      Fare Barriers to Safe Area (North)
----------------------------------                                      ----------------------------------
  airs     -up            2         3          35      =        210     Stairs     -up            2         3          35        210
           -down          0         0          40      =          0                -down          0         0          40          0
  calators-up             2         2          35      =        140     Escalators-up             2         2          35        140
           -down          0         0          40      =          0                -down          0         0          40          0
Emer.      -up            0         0          35      =          0     Emer.      -up            0         0          35          0
Stairs     -down          0         0          40      =          0     Stairs     -down          0         0          40          0
                                                               ----                                                       ----------
                                          Total                 350                                         Total                350

                    EMERGENCY EXIT WIDTH TEST                                              FARE BARRIER TEST
                    -------------------------                                              -----------------
Minimum Platform Exit Width                                                                      Array       South      North
---------------------------                                             Capacity of Fare Gates and Turnstiles     100        100
[=Net Platform Area /(7Sq.Ft. per Person x 50 Persons per Ft.)]                  Percent of Total Capacity      25.00      25.00
Minimum Width Required : Up.=   25.74    Lower=       35.38
Width Provided: Up.=  44.00    Lower=       62.33    [NOT<REQUIRED]
```

```
                    EMERGENCY EXIT CAPICITY TESTS         SHT 3 OF 4WILVERDY.LPE
                    -----------------------------
STATION:  WILSHIRE /VERMONT       DATE: 3/22/89        BY: EHS
                              Test 1
                              ------

Evacuate Total Occupant Load from Platform(s) in 4 minutes or less.

W1(waiting time at platform exits) = Occupant Load  / Exit Capacity

W1U =        1246    /            840     =            1.483   Minutes
W1L =        1980    /           1190     =            1.664   Minutes
                              Test 2
                              ------

Evacuate Total Occupant Load from the most remote point on the
platform to a point of safety in 6 minutes or less.

Walking Time for longest exit route
-----------------------------------
T = T1 + T2 + T3 + T4 + T5 + T6
                                    Feet      / FPM     =        Minutes
T1 (on lower platform)                90        200               0.450
T2 (platform to platform)-up          30         50               0.600
T3 (on upper platform)                54        200               0.270
T4 (platform to concourse)-up         19         50               0.380
T5 (on concourse to safe area)       241        200               1.205
T6 (concourse to grade)-up          40.5         50               0.810
                                                               ----------
                                                    T =           3.715
  itional Waiting Time at Platform Exits
 ----------------------------------------
(W1L- T1)=  1.664    -          0.450     =            1.214   Minutes
(W1U-W1L)=  1.483    -          1.664     =            0.000   Minutes
Additional Waiting Time at Fare Barrier
---------------------------------------
Occupant Load at Concourse =  Total Occupant Load (Lower Platform) - Lower Platform Emergency Stair 4 Minute Capacity
+ Total Occupant Load (Upper Platform) - Upper Platform Emergency Stair 4 Minute Capacity

    1980 - (4 x       560     ) +        1506     - (4 x          140 ) =          946     Patrons

W2 = Concourse Occupant Load / Gate Capacity                                 Check for Unbalanced Flow
W2 =          946    /            800     =            1.183   Minutes     North:   473     /                400 =              1.183
(W2 - W1)=  1.183    -          1.664     =            0.000   Minutes     South:   473     /                400 =              1.183

Additional Waiting Time at Concourse Exits
-----------------------------------------
W3 = Concourse Occupant Load / Exit Capacity
W3 =          946    /            700     =            1.351   Minutes     North:   473     /                350 =              1.351
(W3 - W1)=  1.351    -          1.664     =            0.000   Minutes     South:   473     /                350 =              1.351

Total Exit Time     [=T+(W1-T1)+(W1U-W1L)+(W2-W1)+(W3-W1)]
---------------
TOTAL =     4.929    MINUTES   [NOT > 6 MINUTES]
```

EMERGENCY EXITING CALCULATIONS SHT 4 OF 4WILVERDY.LPE

STATION: WILSHIRE /VERMONT DATE: 3/22/89 BY: EHS

CIAL CONSIDERATION - Lower Platform Occupants Use Emer. Stairs Only.

Test 1

Evacuate Total Occupant Load from Platform in 4 minutes or less.

W1U = 1580 / 840 = 1.881 Minutes

Test 2

Evacuate Total Occupant Load from the most remote point on the platform to a point of safety in 6 minutes or less.

Waiting Time at Platform Exits

(W1U-T3)= 1.881 - 0.270 = 1.611 Minutes

Waiting Time at Fare Barrier

Occupant Load at Concourse = Total Occupant Load (upper) - Upper Platform Emergency Stair 4 Minute Capacity

1580 - (4 x 140) = 1020 Patrons

North: W2U = 510 / 400 = 1.275 Minutes
South: W2U = 510 / 400 = 1.275 Minutes

U - W1U= 1.275 - 1.881 = 0.000 Minutes

Waiting Time at Concourse Exits

North: W3U = 510 / 350 = 1.457 Minutes
South: W3U = 510 / 350 = 1.457 Minutes

W3U - W1U= 1.457 - 1.881 = 0.000 Minutes

Total Exit Time [=(T3+T4+T5+T6)+(W1U-T3)+(W2U-W1U)+(W3U-W1U)]
Upper Platform

Total= 4.276 Minutes [Not > 6 Minutes]

Total Exit Time [=Occupant Load / Emer. Stair Capacity]
Lower Platform

Total = 1980 / 560 = 3.536 Minutes

```
                    EMERGENCY EXITING CALCULATIONS          SHT 1 OF 4WILVERDY.UPE

STATION:  WILSHIRE /VERMONT        DATE: 3/22/89          BY:   EHS
NET PLATFOM AREA:   UPPER =        9010 LOWER =         12384
 CCUPANT LOAD CALCULATION                             DESIGN YR
  ----------------------
PEAK HOUR                                     A.M.                P.M.

LINK LOADS:         INBOUND                  11420                4862
                    OUTBOUND                  5662                9766

ENTRAINING LOADS:   INBOUND                   2863                1999
                    OUTBOUND                   806                1130

PEAK 15 MINUTE LOADS [=PEAK HR. LOAD x 1.15 / 4]
--------------------
LINK LOADS:         INBOUND                   3284                1398
                    OUTBOUND                  1628                2808

ENTRAINING LOADS:   INBOUND                    824                 575
                    OUTBOUND                   232                 325

PEAK HEADWWY        INBOUND                    3.0                 3.0
                    OUTBOUND                   3.0                 3.0

CALCULATED TRAIN LOAD [=PEAK 15 MIN. LINK LOAD / (NO. OF HEADWAYS)]
-------------------- [NO. OF HEADWAYS =INTEGER(15 MIN. / HEADWAY)]
                                              A.M.                P.M.
                    INBOUND                    657                 280
                    OUTBOUND                   326                 562
          [USE NOT<1320]

PEAK ENTRAINING LOAD =[PEAK 15 MIN. LOAD x (4 x HEADWAY / 15 MIN.)]
--------------------                          A.M.                P.M.
                    INBOUND                    660                 460
                    OUTBOUND                   186                 260

TOTAL OCCUPANT LOAD [=CALCULATED TRAIN LOAD + PEAK ENTRAINING LOAD]
-------------------                           A.M.                P.M.
                    UPPER PLATFORM            1506                1580
                    LOWER PLATFORM            1980                1780

DENSITY [=NET PLATFORM AREA / PEAK ENTRAINING LOAD
-------                                       A.M.                P.M.
          [NOT < 4 SQ.FT. / PERSON]  UPR     48.44               34.65
                                     LWR     18.76               26.92

STATION OCCUPANT LOAD [=LOWER + UPPER]        3486                3360
---------------------

TOTAL OCCUPANT LOAD FOR CALCULATIONS          3486
```

```
                EMERGENCY EXIT CAPACITY              SHT 2 OF 4WILVERDY.UPE
                -----------------------

STATION:  WILSHIRE /VERMONT      DATE: 3/22/89        BY:    EHS

 T LANES AND CAPACITY PROVIDED
 ------------------------------

ELEMENT   DIRECTION  NUMBER   x LANES  x CAPACITY    =        PPM
                                         / LANE
Lower Platform to Upper Platform                                   Upper Platform to Concourse
--------------------------------                                   ---------------------------
Stairs     -up           4        3          35       =       420  Stairs     -up           4         3         35       420
           -down         0        0          40       =         0             -down         0         0         40         0
Escalators-up            4        2          35       =       280  Escalators-up *          3         2         35       210
           -down         0        0          40       =         0             -down         0         0         40         0
Emer.      -up           4        4          35       =       560  Emer.      -up           2         2         35       140
Stairs     -down         0        0          40       =         0  Stairs     -down         0         0         40         0
                                                              ----  * Discounted                                  ----------
                                 36    Total                  1260                                  22 Total            770
Through Fare Barriers (South)                                      Through Fare Barriers (North)
-----------------------------                                      -----------------------------
Turnstiles               4        1          25       =       100  Turnstiles               4         1         25       100
Fare Gates               0        1          50       =         0  Fare Gates               0         1         50         0
Service Gates            1        2          50       =       100  Service Gates            1         2         50       100
Emergency Gates          2        2          50       =       200  Emergency Gates          2         2         50       200
                                                              ----                                                ----------
                                       Total                  400                                     Total             400
Fare Barriers to Safe Area (South)                                 Fare Barriers to Safe Area (North)
----------------------------------                                 ----------------------------------
 airs      -up           2        3          35       =       210  Stairs     -up           2         3         35       210
           -down         0        0          40       =         0             -down         0         0         40         0
 alators-up              2        2          35       =       140  Escalators-up            2         2         35       140
           -down         0        0          40       =         0             -down         0         0         40         0
Emer.      -up           0        0          35       =         0  Emer.      -up           0         0         35         0
Stairs     -down         0        0          40       =         0  Stairs     -down         0         0         40         0
                                                              ----                                                ----------
                                       Total                  350                                     Total             350

                EMERGENCY EXIT WIDTH TEST                                    FARE BARRIER TEST
                -------------------------                                    -----------------
Minimum Platform Exit Width                                                            Array      South     North
---------------------------                                        Capacity of Fare Gates and Turnstiles   100       100
[=Net Platform Area /(7Sq.Ft. per Person x 50 Persons per Ft.)]              Percent of Total Capacity   25.00     25.00
Minimum Width Required : Up.=   25.74   Lower=      35.38
Width Provided: Up.=  40.33   Lower=      66.00   [NOT REQUIRED]
```

```
                  EMERGENCY EXIT CAPICITY TESTS          SHT 3 OF 4WILVERDY.UPE
                  ----------------------------
STATION:  WILSHIRE /VERMONT        DATE: 3/22/89         BY: EHS
                        Test 1
                        ------

Evacuate Total Occupant Load from Platform(s) in 4 minutes or less.

W1(waiting time at platform exits) = Occupant Load  / Exit Capacity

W1U =       1246    /          770    =         1.618   Minutes
W1L =       1980    /         1260    =         1.571   Minutes
                        Test 2
                        ------

Evacuate Total Occupant Load from the most remote point on the
platform to a point of safety in 6 minutes or less.

Walking Time for longest exit route
------------------------------------
T = T1 + T2 + T3 + T4 + T5 + T6
                                   Feet     / FPM    =        Minutes
T1 (on lower platform)              90       200               0.450
T2 (platform to platform)-up        30        50               0.600
T3 (on upper platform)              54       200               0.270
T4 (platform to concourse)-up       19        50               0.380
T5 (on concourse to safe area)     241       200               1.205
T6 (concourse to grade)-up        40.5        50               0.810
                                                            ----------
                                                   T =         3.715
  ditional Waiting Time at Platform Exits
  ----------------------------------------
(W1L- T1)=  1.571    -          0.450    =         1.121   Minutes
(W1U-W1L)=  1.618    -          1.571    =         0.047   Minutes
Additional Waiting Time at Fare Barrier
----------------------------------------

Occupant Load at Concourse =  Total Occupant Load (Lower Platform) - Lower Platform Emergency Stair 4 Minute Capacity
+ Total Occupant Load (Upper Platform) - Upper Platform Emergency Stair 4 Minute Capacity

    1980 - (4 x       560     ) +        1506     - (4 x          140 ) =          946    Patrons

W2 = Concourse Occupant Load / Gate Capacity                                Check for Unbalanced Flow
W2 =          946    /          800     =         1.183   Minutes      North:   473     /                400 =          1.183
(W2 - W1)=  1.183    -          1.618   =         0.000   Minutes      South:   473     /                400 =          1.183

Additional Waiting Time at Concourse Exits
------------------------------------------
W3 = Concourse Occupant Load / Exit Capacity
W3 =          946    /          700     =         1.351   Minutes      North:   473     /                350 =          1.351
(W3 - W1)=  1.351    -          1.618   =         0.000   Minutes      South:   473     /                350 =          1.351

Total Exit Time     [=T+(W1-T1)+(W1U-W1L)+(W2-W1)+(W3-W1)]
---------------
TOTAL =      4.883   MINUTES   [NOT > 6 MINUTES]
```

```
                  EMERGENCY EXITING CALCULATIONS        SHT 4 OF 4WILVERDY.UPE
                  ------------------------------
STATION:  WILSHIRE /VERMONT   DATE:    3/22/89   BY:       EHS

   CIAL CONSIDERATION - Lower Platform Occupants Use Emer. Stairs Only.
                              Test 1
                              ------
Evacuate Total Occupant Load from Platform in 4 minutes or less.

W1U =       1580    /           770    =         2.052   Minutes

                              Test 2
                              ------
Evacuate Total Occupant Load from the most remote point on the
platform to a point of safety in 6 minutes or less.

Waiting Time at Platform Exits
------------------------------
(W1U-T3)=   2.052   -          0.270   =         1.782   Minutes

Waiting Time at Fare Barrier
----------------------------
Occupant Load at Concourse = Total Occupant Load (upper) - Upper Plat-
form Emergency Stair 4 Minute Capacity

     1580 - (4 x         140 ) =        1020    Patrons

North:    W2U =          510 /             400 =          1.275   Minutes
South:    W2U =          510 /             400 =          1.275   Minutes

   - W1U=  1.275   -          2.052   =         0.000   Minutes

Waiting Time at Concourse Exits
-------------------------------
North:    W3U =          510 /             350 =          1.457   Minutes
South:    W3U =          510 /             350 =          1.457   Minutes

W3U - W1U=  1.457   -          2.052   =         0.000   Minutes

Total Exit Time [=(T3+T4+T5+T6)+(W1U-T3)+(W2U-W1U)+(W3U-W1U)]
Upper Platform
--------------
Total=      4.447   Minutes   [Not > 6  Minutes]

Total Exit Time     [=Occupant Load / Emer. Stair Capacity]
Lower Platform
--------------
Total =     1980    /              560     =        3.536 Minutes
```

```
                      EMERGENCY EXITING CALCULATIONS        SHT 1 OF 4WILVERDY.CE

STATION:  WILSHIRE /VERMONT       DATE: 3/22/89         BY:   EHS
NET PLATFOM AREA:   UPPER =        9010 LOWER =       12384
OCCUPANT LOAD CALCULATION                          DESIGN YR
----------------------

PEAK HOUR                                     A.M.                P.M.

LINK LOADS:         INBOUND                  11420                4862
                    OUTBOUND                  5662                9766

ENTRAINING LOADS:   INBOUND                   2863                1999
                    OUTBOUND                   806                1130

PEAK 15 MINUTE LOADS [=PEAK HR. LOAD x 1.15 / 4]
--------------------
LINK LOADS:         INBOUND                   3284                1398
                    OUTBOUND                  1628                2808

ENTRAINING LOADS:   INBOUND                    824                 575
                    OUTBOUND                   232                 325

PEAK HEADWWY        INBOUND                    3.0                 3.0
                    OUTBOUND                   3.0                 3.0

CALCULATED TRAIN LOAD [=PEAK 15 MIN. LINK LOAD / (NO. OF HEADWAYS)]
-------------------- [NO. OF HEADWAYS =INTEGER(15 MIN. / HEADWAY)]
                                              A.M.                P.M.
                    INBOUND                    657                 280
                    OUTBOUND                   326                 562
         [USE NOT<1320]

PEAK ENTRAINING LOAD =[PEAK 15 MIN. LOAD x (4 x HEADWAY / 15 MIN.)]
--------------------                          A.M.                P.M.
                    INBOUND                    660                 460
                    OUTBOUND                   186                 260

TOTAL OCCUPANT LOAD [=CALCULATED TRAIN LOAD + PEAK ENTRAINING LOAD]
-------------------                           A.M.                P.M.
                    UPPER PLATFORM            1506                1580
                    LOWER PLATFORM            1980                1780

DENSITY [=NET PLATFORM AREA / PEAK ENTRAINING LOAD
-------                                       A.M.                P.M.
         [NOT < 4 SQ.FT. / PERSON]  UPR      48.44               34.65
                                    LWR      18.76               26.92

STATION OCCUPANT LOAD [=LOWER + UPPER]        3486                3360
---------------------

TOTAL OCCUPANT LOAD FOR CALCULATIONS          3486
```

```
                    EMERGENCY EXIT CAPACITY              SHT 2 OF 4WILVERDY.CE
                    -----------------------
STATION:  WILSHIRE /VERMONT      DATE: 3/22/89        BY:     EHS

 XIT LANES AND CAPACITY PROVIDED
 ------------------------------

ELEMENT   DIRECTION   NUMBER   x LANES   x CAPACITY    =        PPM
                                           / LANE
Lower Platform to Upper Platform                                       Upper Platform to Concourse
--------------------------------                                       ---------------------------
Stairs     -up           4        3           35       =        420    Stairs     -up             4          3         35        420
           -down         0        0           40       =          0               -down           0          0         40          0
Escalators-up            4        2           35       =        280    Escalators-up              4          2         35        280
           -down         0        0           40       =          0               -down           0          0         40          0
Emer.      -up           4        4           35       =        560    Emer.      -up             2          2         35        140
Stairs     -down         0        0           40       =          0    Stairs     -down           0          0         40          0
                                                                ----                                                           ----------
                                 36      Total                  1260                                   24 Total                  840
Through Fare Barriers (South)                                          Through Fare Barriers (North)
-----------------------------                                          -----------------------------
Turnstiles               4        1           25       =        100    Turnstiles                 4          1         25        100
Fare Gates               0        1           50       =          0    Fare Gates                 0          1         50          0
Service Gates            1        2           50       =        100    Service Gates              1          2         50        100
Emergency Gates          2        2           50       =        200    Emergency Gates            2          2         50        200
                                                                ----                                                           ----------
                                         Total                  400                                       Total                  400
Fare Barriers to Safe Area (South)                                     Fare Barriers to Safe Area (North)
----------------------------------                                     ----------------------------------
 tairs     -up           2        3           35       =        210    Stairs     -up             2          3         35        210
           -down         0        0           40       =          0               -down           0          0         40          0
 calators-up *           1        2           35       =         70    Escalators-up              2          2         35        140
           -down         0        0           40       =          0               -down           0          0         40          0
Emer.      -up           0        0           35       =          0    Emer.      -up             0          0         35          0
Stairs     -down         0        0           40       =          0    Stairs     -down           0          0         40          0
* Discounted                                                    ----                                                           ----------
                                         Total                  280                                       Total                  350

                    EMERGENCY EXIT WIDTH TEST                                          FARE BARRIER TEST
                    -------------------------                                          -----------------
Minimum Platform Exit Width                                                                  Arrav      South      North
---------------------------                                            Capacity of Fare Gates and Turnstiles    100        100
[=Net Platform Area /(7Sq.Ft. per Person x 50 Persons per Ft.)]                Percent of Total Capacity        25.00      25.00
Minimum Width Required : Up.=    25.74   Lower=      35.38
Width Provided: Up.=  44.00   Lower=      66.00   [NOT<REQUIRED]
```

```
                    EMERGENCY EXIT CAPICITY TESTS        SHT 3 OF 4WILVERDY.CE
                    -----------------------------
STATION:  WILSHIRE /VERMONT       DATE: 3/22/89        BY: EHS
                              Test 1
                              ------

Evacuate Total Occupant Load from Platform(s) in 4 minutes or less.

W1(waiting time at platform exits) = Occupant Load  / Exit Capacity

W1U =        1246    /           840     =          1.483   Minutes
W1L =        1980    /          1260     =          1.571   Minutes
                              Test 2
                              ------

Evacuate Total Occupant Load from the most remote point on the
platform to a point of safety in 6 minutes or less.

Walking Time for longest exit route
-----------------------------------
T = T1 + T2 + T3 + T4 + T5 + T6
                                    Feet      / FPM     =        Minutes
T1 (on lower platform)               90        200                 0.450
T2 (platform to platform)-up         30         50                 0.600
T3 (on upper platform)               54        200                 0.270
T4 (platform to concourse)-up        19         50                 0.380
T5 (on concourse to safe area)      241        200                 1.205
T6 (concourse to grade)-up         40.5         50                 0.810
                                                                ----------
                                                      T =          3.715
  itional Waiting Time at Platform Exits
  --------------------------------------
(W1L- T1)=  1.571    -         0.450    =          1.121   Minutes
(W1U-W1L)=  1.483    -         1.571    =          0.000   Minutes
Additional Waiting Time at Fare Barrier
---------------------------------------

Occupant Load at Concourse =  Total Occupant Load (Lower Platform) - Lower Platform Emergency Stair 4 Minute Capacity
+ Total Occupant Load (Upper Platform) - Upper Platform Emergency Stair 4 Minute Capacity

    1980 - (4 x       560     ) +         1506     - (4 x          140 ) =          946    Patrons

W2 = Concourse Occupant Load / Gate Capacity                              Check for Unbalanced Flow
W2 =          946    /           800     =          1.183   Minutes      North:   473    /              400 =            1.183
(W2 - W1)=  1.183    -         1.571     =          0.000   Minutes      South:   473    /              400 =            1.183

Additional Waiting Time at Concourse Exits
------------------------------------------

W3 = Concourse Occupant Load / Exit Capacity
W3 =          946    /           630     =          1.502   Minutes      North:   473    /              350 =            1.351
(W3 - W1)=  1.689    -         1.571     =          0.118   Minutes      South:   473    /              280 =            1.689

Total Exit Time     [=T+(W1-T1)+(W1U-W1L)+(W2-W1)+(W3-W1)]
---------------
TOTAL =     4.954   MINUTES   [NOT > 6 MINUTES]
```

EMERGENCY EXITING CALCULATIONS

SHT 4 OF 4WILVERDY.CE

STATION: WILSHIRE /VERMONT DATE: 3/22/89 BY: EHS

CIAL CONSIDERATION - Lower Platform Occupants Use Emer. Stairs Only.

Test 1

Evacuate Total Occupant Load from Platform in 4 minutes or less.

W1U = 1580 / 840 = 1.881 Minutes

Test 2

Evacuate Total Occupant Load from the most remote point on the platform to a point of safety in 6 minutes or less.

Waiting Time at Platform Exits

(W1U-T3)= 1.881 - 0.270 = 1.611 Minutes

Waiting Time at Fare Barrier

Occupant Load at Concourse = Total Occupant Load (upper) - Upper Platform Emergency Stair 4 Minute Capacity

1580 - (4 x 140) = 1020 Patrons

North: W2U = 510 / 400 = 1.275 Minutes
South: W2U = 510 / 400 = 1.275 Minutes

- W1U= 1.275 - 1.881 = 0.000 Minutes

Waiting Time at Concourse Exits

North: W3U = 510 / 350 = 1.457 Minutes
South: W3U = 510 / 280 = 1.821 Minutes

W3U - W1U= 1.821 - 1.881 = 0.000 Minutes

Total Exit Time [=(T3+T4+T5+T6)+(W1U-T3)+(W2U-W1U)+(W3U-W1U)]
Upper Platform

Total= 4.276 Minutes [Not > 6 Minutes]

Total Exit Time [=Occupant Load / Emer. Stair Capacity]
Lower Platform

Total = 1980 / 560 = 3.536 Minutes

— ATTACHMENT A.1 —

Rolf Jensen & Associates, Inc.

FIRE PROTECTION ENGINEERS • BUILDING CODE CONSULTANTS

June 21, 1989

FEDERAL EXPRESS
(213)612-7000

Mr. Malcolm Ingram
Metro Rail Transit Consultants
548 South Spring Street, 7th Floor
Los Angeles, California 90013

WILSHIRE/VERMONT
PRELIMINARY ARCHITECTURAL REVIEW

Malcolm:

We have reviewed the drawings and sketches which accompanied your speed letter of June 9, 1989.

Updated exit calculations are attached. In all three sets, one escalator was discounted. Maximum egress times are as follows:

Discounted Escalator at	Egress Time, Minutes
Lower Platform (.LPE)	6.378
Upper Platform (.UPE)	6.891
Concourse (.CE)	6.338

All of the total exit times exceed 6 minutes. The exit capacity does not meet the Fire/Life Safety Criteria. Upper platform exiting capacity needs to be increased.

We have the following comments from our review of the drawings:

Ref No.	Drawing	Comment
1	SKA-02 SKA-07	Guardrails are needed opposite doors from ancillary spaces to trainway.
2	SKA-12 SKA-15	In Aux. Power Room batteries should be separated from other equipment for ventilation purposes.
3	SKA-13	Ventilation and generator exhaust may be a problem. Another shaft may be needed to serve the emergency generator room.

Ref No.	Drawing	Comment
4	SKA-25	The lower platform is more than 80 feet below finished grade. Protected level separation or other special protection features will be needed to comply with Fire/Life Safety Criteria 2.2.2.3.

If you have a question or would like to discuss our comments, please call.

Sincerely,

David R. Fiedler, P.E.

DRF:jmp - Wilshire/Vermont

Enclosure

5381C

```
                EMERGENCY EXITING CALCULATIONS        SHT 1 OF 4 [redacted]

STATION: [redacted]          DATE: [redacted]         BY:   CAF
NET PLATFOM AREA:   UPPER =        9501 LOWER =       14624
OCCUPANT LOAD CALCULATION                        DESIGN YR
 -----------------------
 .AK HOUR                                  A.M.             P.M.

LINK LOADS:         INBOUND               11420             4862
                    OUTBOUND               5662             9766

ENTRAINING LOADS:   INBOUND                2863             1999
                    OUTBOUND                806             1130

PEAK 15 MINUTE LOADS [=PEAK HR. LOAD x 1.15 / 4]
--------------------
LINK LOADS:         INBOUND                3284             1398
                    OUTBOUND               1628             2808

ENTRAINING LOADS:   INBOUND                 824              575
                    OUTBOUND                232              325

PEAK HEADWAY        INBOUND                 3.0              3.0
                    OUTBOUND                3.0              3.0

CALCULATED TRAIN LOAD [=PEAK 15 MIN. LINK LOAD / (NO. OF HEADWAYS)]
--------------------- [NO. OF HEADWAYS =INTEGER(15 MIN. / HEADWAY)]
                                           A.M.             P.M.
                    INBOUND                 657              280
                    OUTBOUND                326              562
        [USE NOT<1320]

PEAK ENTRAINING LOAD =[PEAK 15 MIN. LOAD x (4 x HEADWAY / 15 MIN.)]
--------------------                       A.M.             P.M.
                    INBOUND                 660              460
                    OUTBOUND                186              260

TOTAL OCCUPANT LOAD [=CALCULATED TRAIN LOAD + PEAK ENTRAINING LOAD]
-------------------                        A.M.             P.M.
                    UPPER PLATFORM         1506             1560
                    LOWER PLATFORM         1980             1790

DENSITY [=NET PLATFORM AREA / PEAK ENTRAINING LOAD
-------                                    A.M.             P.M.
        [NOT < 4 SQ.FT. / PERSON]  UPR    51.08            35.54
                                   LWR    22.16            31.79

STATION OCCUPANT LOAD [=LOWER + UPPER]     3486             3360
---------------------

TOTAL OCCUPANT LOAD FOR CALCULATIONS       3486
```

```
                  EMERGENCY EXIT CAPACITY             SHT 2 OF 4 WVDYCAF.LPE
                  -----------------------
STATION:  WILSHIRE /VERMONT      DATE: 6/21/89        BY:    CAF

EXIT LANES AND CAPACITY PROVIDED
--------------------------------

ELEMENT   DIRECTION   NUMBER   x LANES   x CAPACITY    =         PPM
                                            / LANE
Lower Platform to Upper Platform                                      Upper Platform to Concourse
--------------------------------                                      ---------------------------
Stairs      -up          2        3          35        =         210  Stairs      -up          2        3        35       210
            -down        0        0          40        =           0              -down        0        0        40         0
Escalators-up *          3        2          35        =         210  Escalators-up            2        2        35       140
            -down        0        0          40        =           0              -down        0        0        40         0
Emer.       -up          4        4          35        =         560  Emer.       -up          2        2        35       140
Stairs      -down        0        0          40        =           0  Stairs      -down        0        0        40         0
* Discounted                                                    ----                                               ----------
                                 28     Total                    980                                14 Total             490
Through Fare Barriers (South)                                         Through Fare Barriers (North)
-----------------------------                                         -----------------------------
Turnstiles               4        1          25        =         100  Turnstiles               4        1        25       100
Fare Gates               0        1          50        =           0  Fare Gates               0        1        50         0
Service Gates            0        2          50        =           0  Service Gates            0        2        50         0
Emergency Gates          1        2          50        =         100  Emergency Gates          1        2        50       100
                                                                ----                                               ----------
                                        Total                    200                                   Total             200
Fare Barriers to Safe Area (South)                                    Fare Barriers to Safe Area (North)
----------------------------------                                    ----------------------------------
Stairs      -up          2        3          35        =         210  Stairs      -up          2        3        35       210
            -down        0        0          40        =           0              -down        0        0        40         0
  calators-up            2        2          35        =         140  Escalators-up            2        2        35       140
            -down        0        0          40        =           0              -down        0        0        40         0
Emer.       -up          0        0          35        =           0  Emer.       -up          0        0        35         0
Stairs      -down        0        0          40        =           0  Stairs      -down        0        0        40         0
                                                                ----                                               ----------
                                        Total                    350                                   Total             350

                  EMERGENCY EXIT WIDTH TEST                                         FARE BARRIER TEST
                  -------------------------                                         -----------------
Minimum Platform Exit Width                                                         Array      South      North
---------------------------                                           Capacity of Fare Gates and Turnstiles   100        100
[=Net Platform Area /(7Sq.Ft. per Person x 50 Persons per Ft.)]              Percent of Total Capacity     50.00      50.00
Minimum Width Required : Up.=   27.15   Lower=      41.78
Width Provided: Up.=  25.67   Lower=       51.33   [NOT REQUIRED]
```

```
                    EMERGENCY EXIT CAPICITY TESTS          SHT 3 OF 4 WVDYCAF.LPE
                    -----------------------------
STATION:  WILSHIRE /VERMONT       DATE: 6/21/89         BY: CAF
                              Test 1
                              ------

Evacuate Total Occupant Load from Platform(s) in 4 minutes or less.

W1(waiting time at platform exits) = Occupant Load  / Exit Capacity

W1U =        1506   /            490    =           3.073   Minutes
W1L =        1980   /            980    =           2.020   Minutes
                              Test 2
                              ------

Evacuate Total Occupant Load from the most remote point on the
platform to a point of safety in 6 minutes or less.

Walking Time for longest exit route
-----------------------------------
T = T1 + T2 + T3 + T4 + T5 + T6
                                    Feet     / FPM     =         Minutes
T1 (on lower platform)               96       200                 0.480
T2 (platform to platform)-up         30        50                 0.600
T3 (on upper platform)              142       200                 0.710
T4 (platform to concourse)-up        21        50                 0.420
T5 (on concourse to safe area)      195       200                 0.975
T6 (concourse to grade)-up           30        50                 0.600
                                                              ----------
                                                   T =            3.785
Additional Waiting Time at Platform Exits
-----------------------------------------
(W1L- T1)=  2.020    -          0.480    =           1.540   Minutes
(W1U-W1L)=  3.073    -          2.020    =           1.053   Minutes
Additional Waiting Time at Fare Barrier
----------------------------------------
Occupant Load at Concourse =  Total Occupant Load (Lower Platform) - Lower Platform Emergency Stair 4 Minute Capacity
+ Total Occupant Load (Upper Platform) - Upper Platform Emergency Stair 4 Minute Capacity

    1980 - (4 x       560    ) +       ( 1506    - (4 x          140 ) =          946    Patrons

W2 = Concourse Occupant Load / Gate Capacity                              Check for Unbalanced Flow
W2 =          946     /           400     =           2.365   Minutes      North:   473     /                200 =           2.365
(W2 - W1)=  2.365    -          3.073     =           0.000   Minutes      South:   473     /                200 =           2.365

Additional Waiting Time at Concourse Exits
-----------------------------------------
W3 = Concourse Occupant Load / Exit Capacity
W3 =          946     /           700     =           1.351   Minutes      North:   473     /                350 =           1.351
(W3 - W1)=  1.351    -          3.073     =           0.000   Minutes      South:   473     /                350 =           1.351

Total Exit Time     [=T+(W1-T1)+(W1U-W1L)+(W2-W1)+(W3-W1)]
---------------
TOTAL =      6.378   MINUTES   [NOT > 6 MINUTES]
```

```
                    EMERGENCY EXITING CALCULATIONS         SHT 4 OF 4 WVDYCAF.LPE
                    ------------------------------
STATION:  WILSHIRE /VERMONT   DATE:     6/21/89   BY:       CAF

SPECIAL CONSIDERATION - Lower Platform Occupants Use Emer. Stairs Only.
                              Test 1
                              ------

Evacuate Total Occupant Load from Platform in 4 minutes or less.

W1U =       1580    /            490    =           3.224  Minutes

                              Test 2
                              ------

Evacuate Total Occupant Load from the most remote point on the
platform to a point of safety in 6 minutes or less.

Waiting Time at Platform Exits
------------------------------
(W1U-T3)=  3.224   -           0.710    =           2.514  Minutes

Waiting Time at Fare Barrier
----------------------------
Occupant Load at Concourse = Total Occupant Load (upper) - Upper Plat-
form Emergency Stair 4 Minute Capacity

     1580 - (4 x         140 ) =        1020    Patrons

North:    W2U =          510 /              200 =          2.550   Minutes
South:    W2U =          510 /              200 =          2.550   Minutes

  U - W1U=  2.550   -           3.224    =           0.000   Minutes

Waiting Time at Concourse Exits
-------------------------------
North:    W3U =          510 /              350 =          1.457   Minutes
South:    W3U =          510 /              350 =          1.457   Minutes

W3U - W1U=  1.457   -           3.224    =           0.000   Minutes

Total Exit Time [=(T3+T4+T5+T6)-(W1U-T3)+(W2U-W1U)+(W3U-W1U)]
Upper Platform
--------------
Total=      5.219   Minutes   [Not > 6  Minutes]

Total Exit Time     [=Occupant Load / Emer. Stair Capacity]
Lower Platform
--------------
Total =     1980    /               560     =         3.536 Minutes
```

```
                    EMERGENCY EXITING CALCULATIONS          SHT 1 OF 4 [redacted]

STATION: [redacted]              DATE: [redacted]            BY:   CAF
NET PLATFOM AREA:    UPPER =          9501 LOWER =          14624
OCCUPANT LOAD CALCULATION                              DESIGN YR
------------------------
 .AK HOUR                                        A.M.                  P.M.

LINK LOADS:          INBOUND                    11420                  4862
                     OUTBOUND                    5662                  9766

ENTRAINING LOADS:    INBOUND                     2863                  1999
                     OUTBOUND                     806                  1130

PEAK 15 MINUTE LOADS [=PEAK HR. LOAD x 1.15 / 4]
-------------------
LINK LOADS:          INBOUND                     3284                  1398
                     OUTBOUND                    1628                  2808

ENTRAINING LOADS:    INBOUND                      824                   575
                     OUTBOUND                     232                   325

PEAK HEADWAY         INBOUND                      3.0                   3.0
                     OUTBOUND                     3.0                   3.0

CALCULATED TRAIN LOAD [=PEAK 15 MIN. LINK LOAD / (NO. OF HEADWAYS)]
-------------------- [NO. OF HEADWAYS =INTEGER(15 MIN. / HEADWAY)]
                                                 A.M.                  P.M.
                     INBOUND                      657                   280
                     OUTBOUND                     326                   562
         [USE NOT<1320]

PEAK ENTRAINING LOAD =[PEAK 15 MIN. LOAD x (4 x HEADWAY / 15 MIN.)]
-------------------                              A.M.                  P.M.
                     INBOUND                      560                   460
                     OUTBOUND                     186                   260

TOTAL OCCUPANT LOAD [=CALCULATED TRAIN LOAD + PEAK ENTRAINING LOAD]
------------------                               A.M.                  P.M.
                     UPPER PLATFORM              1506                  1580
                     LOWER PLATFORM              1980                  1780

DENSITY [=NET PLATFORM AREA / PEAK ENTRAINING LOAD
-------                                          A.M.                  P.M.
         [NOT < 4 SQ.FT. / PERSON]  UPR         51.08                 36.54
                                    LWR         22.16                 31.79

STATION OCCUPANT LOAD [=LOWER + UPPER]          3486                  3360
--------------------

TOTAL OCCUPANT LOAD FOR CALCULATIONS            3486
```

EMERGENCY EXIT CAPACITY

SHT 2 OF 4 WVDYCAF.UPE

STATION: WILSHIRE /VERMONT DATE: 6/21/89 BY: CAF

EXIT LANES AND CAPACITY PROVIDED

Lower Platform to Upper Platform

ELEMENT	DIRECTION	NUMBER	x LANES	x CAPACITY / LANE	=	PPM
Stairs	-up	2	3	35	=	210
	-down	0	0	40	=	0
Escalators	-up	4	2	35	=	280
	-down	0	0	40	=	0
Emer.	-up	4	4	35	=	560
Stairs	-down	0	0	40	=	0
			30	Total		1050

Upper Platform to Concourse

ELEMENT	DIRECTION	NUMBER	x LANES	x CAPACITY / LANE	PPM
Stairs	-up	2	3	35	210
	-down	0	0	40	0
Escalators	-up *	1	2	35	70
	-down	0	0	40	0
Emer.	-up	2	2	35	140
Stairs	-down	0	0	40	0
			12	Total	420

* Discounted

Through Fare Barriers (South)

ELEMENT	NUMBER	x LANES	x CAPACITY / LANE	=	PPM
Turnstiles	4	1	25	=	100
Fare Gates	0	1	50	=	0
Service Gates	0	2	50	=	0
Emergency Gates	1	2	50	=	100
			Total		200

Through Fare Barriers (North)

ELEMENT	NUMBER	x LANES	x CAPACITY / LANE	PPM
Turnstiles	4	1	25	100
Fare Gates	0	1	50	0
Service Gates	0	2	50	0
Emergency Gates	1	2	50	100
			Total	200

Fare Barriers to Safe Area (South)

ELEMENT	DIRECTION	NUMBER	x LANES	x CAPACITY / LANE	=	PPM
Stairs	-up	2	3	35	=	210
	-down	0	0	40	=	0
calators	-up	2	2	35	=	140
	-down	0	0	40	=	0
Emer.	-up	0	0	35	=	0
Stairs	-down	0	0	40	=	0
				Total		350

Fare Barriers to Safe Area (North)

ELEMENT	DIRECTION	NUMBER	x LANES	x CAPACITY / LANE	PPM
Stairs	-up	2	3	35	210
	-down	0	0	40	0
Escalators	-up	2	2	35	140
	-down	0	0	40	0
Emer.	-up	0	0	35	0
Stairs	-down	0	0	40	0
				Total	350

EMERGENCY EXIT WIDTH TEST

Minimum Platform Exit Width

[=Net Platform Area /(7Sq.Ft. per Person x 50 Persons per Ft.)]

Minimum Width Required : Up.= 27.15 Lower= 41.78

Width Provided: Up.= 22.00 Lower= 55.00 [NOT<REQUIRED]

FARE BARRIER TEST

Array	South	North
Capacity of Fare Gates and Turnstiles	100	100
Percent of Total Capacity	50.00	50.00

EMERGENCY EXIT CAPICITY TESTS

STATION: WILSHIRE /VERMONT DATE: 6/21/89 BY: CAF

Test 1

Evacuate Total Occupant Load from Platform(s) in 4 minutes or less.

W1(waiting time at platform exits) = Occupant Load / Exit Capacity

W1U =	1506	/	420	=	3.586	Minutes
W1L =	1980	/	1050	=	1.886	Minutes

Test 2

Evacuate Total Occupant Load from the most remote point on the platform to a point of safety in 6 minutes or less.

Walking Time for longest exit route

T = T1 + T2 + T3 + T4 + T5 + T6

	Feet	/ FPM	=	Minutes
T1 (on lower platform)	96	200		0.480
T2 (platform to platform)-up	30	50		0.600
T3 (on upper platform)	142	200		0.710
T4 (platform to concourse)-up	21	50		0.420
T5 (on concourse to safe area)	195	200		0.975
T6 (concourse to grade)-up	30	50		0.600
			T =	3.785

Additional Waiting Time at Platform Exits

(W1L- T1)=	1.886	-	0.480	=	1.406	Minutes
(W1U-W1L)=	3.586	-	1.886	=	1.700	Minutes

Additional Waiting Time at Fare Barrier

Occupant Load at Concourse = Total Occupant Load (Lower Platform) - Lower Platform Emergency Stair 4 Minute Capacity + Total Occupant Load (Upper Platform) - Upper Platform Emergency Stair 4 Minute Capacity

1980 - (4 x 560) + 1506 - (4 x 140) = 946 Patrons

W2 = Concourse Occupant Load / Gate Capacity

W2 =	946	/	400	=	2.365	Minutes	North:	473	/	200 =	2.365
(W2 - W1)=	2.365	-	3.586	=	0.000	Minutes	South:	473		200 =	2.365

Check for Unbalanced Flow

Additional Waiting Time at Concourse Exits

W3 = Concourse Occupant Load / Exit Capacity

W3 =	946	/	700	=	1.351	Minutes	North:	473	/	350 =	1.351
(W3 - W1)=	1.351	-	3.586	=	0.000	Minutes	South:	473	/	350 =	1.351

Total Exit Time [=T+(W1-T1)+(W1U-W1L)+(W2-W1)+(W3-W1)]

TOTAL = 6.891 MINUTES (NOT > 6 MINUTES)

```
                    EMERGENCY EXITING CALCULATIONS        SHT 4 OF 4 WVDYCAF.UPE
                    ------------------------------
STATION:  WILSHIRE /VERMONT   DATE:     6/21/89   BY:       CAF

ECIAL CONSIDERATION - Lower Platform Occupants Use Emer. Stairs Only.
                              Test 1
                              ------
Evacuate Total Occupant Load from Platform in 4 minutes or less.

W1U =       1580    /          420    =          3.762   Minutes

                              Test 2
                              ------
Evacuate Total Occupant Load from the most remote point on the
platform to a point of safety in 6 minutes or less.

Waiting Time at Platform Exits
------------------------------
(W1U-T3)=   3.762   -          0.710   =          3.052   Minutes

Waiting Time at Fare Barrier
----------------------------
Occupant Load at Concourse = Total Occupant Load (upper) - Upper Plat-
form Emergency Stair 4 Minute Capacity

     1580 - (4 x          140 ) =         1020     Patrons

North:    W2U =           510 /               200 =           2.550   Minutes
South:    W2U =           510 /               200 =           2.550   Minutes

 U - W1U=  2.550   -          3.762   =          0.000   Minutes

Waiting Time at Concourse Exits
-------------------------------
North:    W3U =           510 /               350 =           1.457   Minutes
South:    W3U =           510 /               350 =           1.457   Minutes

W3U - W1U=  1.457   -          3.762   =          0.000   Minutes

Total Exit Time [=(T3+T4+T5+T6)+(W1U-T3)+(W2U-W1U)+(W3U-W1U)]
Upper Platform
--------------
Total=      5.757   Minutes  [Not > 6  Minutes]

Total Exit Time     [=Occupant Load / Emer. Stair Capacity]
Lower Platform
--------------
Total =     1980    /             560     =          3.536 Minutes
```

```
                 EMERGENCY EXITING CALCULATIONS         SHT 1 OF 4[redacted]

STATION: [redacted]              DATE: [redacted]          BY:   CAF
NET PLATFOM AREA:   UPPER =          9501 LOWER =       14624
OCCUPANT LOAD CALCULATION                          DESIGN YR
 ------------------------
 PEAK HOUR                                  A.M.              P.M.

LINK LOADS:         INBOUND                11420              4852
                    OUTBOUND                5662              9766

ENTRAINING LOADS:   INBOUND                 2363              1999
                    OUTBOUND                 806              1130

PEAK 15 MINUTE LOADS [=PEAK HR. LOAD x 1.15 / 4]
--------------------
LINK LOADS:         INBOUND                 3284              1398
                    OUTBOUND                1628              2808

ENTRAINING LOADS:   INBOUND                  824               575
                    OUTBOUND                 232               325

PEAK HEADWWY        INBOUND                  3.0               3.0
                    OUTBOUND                 3.0               3.0

CALCULATED TRAIN LOAD [=PEAK 15 MIN. LINK LOAD / (NO. OF HEADWAYS)]
--------------------- [NO. OF HEADWAYS =INTEGER(15 MIN. / HEADWAY)]
                                            A.M.              P.M.
                    INBOUND                  657               280
                    OUTBOUND                 326               562
        [USE NOT<1320]

PEAK ENTRAINING LOAD =[PEAK 15 MIN. LOAD x (4 x HEADWAY / 15 MIN.)]
--------------------                        A.M.              P.M.
                    INBOUND                  660               460
                    OUTBOUND                 136               260

TOTAL OCCUPANT LOAD [=CALCULATED TRAIN LOAD + PEAK ENTRAINING LOAD]
-------------------                         A.M.              P.M.
                    UPPER PLATFORM          1506              1580
                    LOWER PLATFORM          1980              1760

DENSITY [=NET PLATFORM AREA / PEAK ENTRAINING LOAD
-------                                     A.M.              P.M.
        (NOT < 4 SQ.FT. / PERSON)  UPR     51.08             36.54
                                   LWR     22.16             31.79

STATION OCCUPANT LOAD [=LOWER + UPPER]      3486              3360
--------------------

TOTAL OCCUPANT LOAD FOR CALCULATIONS        3486
```

```
                EMERGENCY EXIT CAPACITY                SHT 2 OF 4 WVDYCAF.CE
                -----------------------
STATION:  WILSHIRE /VERMONT      DATE: 6/21/89        BY:    CAF

EXIT LANES AND CAPACITY PROVIDED
--------------------------------

ELEMENT   DIRECTION   NUMBER   x LANES  x CAPACITY    =        FPM
                                          / LANE
Lower Platform to Upper Platform                                      Upper Platform to Concourse
--------------------------------                                      ---------------------------
Stairs      -up          2         3          35      =        210    Stairs     -up          2         3        35        210
            -down        0         0          40      =          0               -down        0         0        40          0
Escalators-up            4         2          35      =        280    Escalators-up           2         2        35        140
            -down        0         0          40      =          0               -down        0         0        40          0
Emer.       -up          4         4          35      =        560    Emer.      -up          2         2        35        140
Stairs      -down        0         0          40      =          0    Stairs     -down        0         0        40          0
                                                               ----                                                  ----------
                                  30      Total                1050                                    14 Total           490
Through Fare Barriers (South)                                         Through Fare Barriers (North)
-----------------------------                                         -----------------------------
Turnstiles               4         1          25      =        100    Turnstiles              4         1        25        100
Fare Gates               0         1          50      =          0    Fare Gates              0         1        50          0
Service Gates            0         2          50      =          0    Service Gates           0         2        50          0
Emergency Gates          1         2          50      =        100    Emergency Gates         1         2        50        100
                                                               ----                                                  ----------
                                          Total                 200                                       Total           200
Fare Barriers to Safe Area (South)                                    Fare Barriers to Safe Area (North)
----------------------------------                                    ----------------------------------
Stairs      -up          2         3          35      =        210    Stairs     -up          2         3        35        210
            -down        0         0          40      =          0               -down        0         0        40          0
  calators-up *          1         2          35      =         70    Escalators-up           2         2        35        140
            -down        0         0          40      =          0               -down        0         0        40          0
Emer.       -up          0         0          35      =          0    Emer.      -up          0         0        35          0
Stairs      -down        0         0          40      =          0    Stairs     -down        0         0        40          0
* Discounted                                                   ----                                                  ----------
                                          Total                 280                                       Total           350

                EMERGENCY EXIT WIDTH TEST                                            FARE BARRIER TEST
                -------------------------                                            -----------------
Minimum Platform Exit Width                                                           Array        South      North
---------------------------                                           Capacity of Fare Gates and Turnstiles     100        100
[=Net Platform Area /(7Sq.Ft. per Person x 50 Persons per Ft.)]               Percent of Total Capacity    30.00      50.00
Minimum Width Required : Up.=   27.15    Lower=      41.78
Width Provided: Up.=  25.67   Lower=      55.00   [NOT REQUIRED]
```

```
                  EMERGENCY EXIT CAPICITY TESTS          SHT 3 OF 4WILVERDY.CE
                  -----------------------------
STATION:  WILSHIRE /VERMONT       DATE: 6/21/89         BY: CAF
                                Test 1
                                ------

Evacuate Total Occupant Load from Platform(s) in 4 minutes or less.

W1(waiting time at platform exits) = Occupant Load  / Exit Capacity

W1U =       1506    /           490    =            3.073   Minutes
W1L =       1980    /          1050    =            1.886   Minutes
                                Test 2
                                ------

Evacuate Total Occupant Load from the most remote point on the
platform to a point of safety in 6 minutes or less.

Walking Time for longest exit route
-----------------------------------
T = T1 + T2 + T3 + T4 + T5 + T6
                                     Feet     / FPM    =        Minutes
T1 (on lower platform)                 90      200               0.450
T2 (platform to platform)-up           30       50               0.600
T3 (on upper platform)                 54      200               0.270
T4 (platform to concourse)-up          19       50               0.380
T5 (on concourse to safe area)        241      200               1.205
T6 (concourse to grade)-up           40.5       50               0.810
                                                               ----------
                                                       T =       3.715
Additional Waiting Time at Platform Exits
 ----------------------------------------
(W1L- T1)=  1.886   -           0.450   =            1.436   Minutes
(W1U-W1L)=  3.073   -           1.886   =            1.188   Minutes
Additional Waiting Time at Fare Barrier
----------------------------------------
Occupant Load at Concourse =  Total Occupant Load (Lower Platform) - Lower Platform Emergency Stair 4 Minute Capacity
+ Total Occupant Load (Upper Platform) - Upper Platform Emergency Stair 4 Minute Capacity

    1980 - (4 x       560     ) +        1506     - (4 x          140 ) =          946    Patrons

W2 = Concourse Occupant Load / Gate Capacity                          Check for Unbalanced Flow
W2 =          946     /          400     =            2.365   Minutes      North:   473     /              200 =             2.365
(W2 - W1)=  2.365   -          3.073    =            0.000   Minutes      South:   473     /              200 =             2.365

Additional Waiting Time at Concourse Exits
------------------------------------------
W3 = Concourse Occupant Load / Exit Capacity
W3 =          946     /          630     =            1.502   Minutes      North:   473     /              350 =             1.351
(W3 - W1)=  1.689   -          3.073    =            0.000   Minutes      South:   473     .              280 =             1.689

Total Exit Time      [=T+(W1-T1)+(W1U-W1L)+(W2-W1)+(W3-W1)]
---------------
TOTAL =      6.338   MINUTES   [NOT > 6 MINUTES]
```

```
                    EMERGENCY EXITING CALCULATIONS         SHT 4 OF 4WILVERDY.CE
                    ------------------------------
STATION:  WILSHIRE /VERMONT   DATE:     6/21/89   BY:      CAF

  ECIAL CONSIDERATION - Lower Platform Occupants Use Emer. Stairs Only.
                              Test 1
                              ------

Evacuate Total Occupant Load from Platform in 4 minutes or less.

W1U =       1580    /          490     =          3.224   Minutes

                              Test 2
                              ------

Evacuate Total Occupant Load from the most remote point on the
platform to a point of safety in 6 minutes or less.

Waiting Time at Platform Exits
------------------------------
(W1U-T3)=   3.224   -          0.270   =          2.954   Minutes

Waiting Time at Fare Barrier
----------------------------
Occupant Load at Concourse = Total Occupant Load (upper) - Upper Plat-
form Emergency Stair 4 Minute Capacity

    1580 - (4 x         140 ) =        1020    Patrons

North:    W2U =          510 /               200 =          2.550   Minutes
South:    W2U =          510 /               200 =          2.550   Minutes

  U - W1U=  2.550   -          3.224   =          0.000   Minutes

Waiting Time at Concourse Exits
-------------------------------
North:    W2U =          510 /               350 =          1.457   Minutes
South:    W3U =          510                 280 =          1.821   Minutes

W3U - W1U=  1.821   -          3.224   =          0.000   Minutes

Total Exit Time [=(T3+T4+T5+T6)+(W1U-T3)+(W2U-W1U)+(W3U-W1U)]
Upper Platform
--------------
Total=      5.619   Minutes   [Not > 6  Minutes]

Total Exit Time     [=Occupant Load / Emer. Stair Capacity]
Lower Platform
--------------
Total =     1980    /             560     =        3.536 Minutes
```

83-32101

— ATTACHMENT B —

Rolf Jensen & Associates, Inc.
FIRE PROTECTION ENGINEERS • BUILDING CODE CONSULTANTS

RECEIVED
MAR 15 1989
R.C.C.

March 14, 1989

FEDERAL EXPRESS
(213)612-7000

RECEIVED BY, MRTC
MAR 16 1989
SAFETY & ASSURANCE

Mr. Malcolm Ingram
Metro Rail Transit Consultants
548 South Spring Street, 7th Floor
Los Angeles, CA 90013

PRELIMINARY EXIT
CALCULATIONS

Malcolm:

Copies of preliminary exit calculations for Hollywood/Highland and Hollywood/Vine are enclosed. As we discussed, the Wilshire/Alvarado Station configuration was used.

Each station will have the following circulation elements:

Platform to Mezzanine
2 3-unit emergency stairs
2 3-unit normal stairs
2 2-unit escalators

Mezzanine to Grade
2 3-unit normal stairs
2 2-unit escalators

These calculations will be updated as the preliminary plans become available. If you have a question, please call.

Sincerely,

David R. Fiedler

David R. Fiedler, P.E.

DRF:jmp - H3275.01

Enclosure

5252 Hollister Road • Houston, Texas 77040 • 713/462-1840 • FAX 462-0812

```
                     EMERGENCY EXITING CALCULATIONS         SHT 1 OF 3

STATION:  Hollywood/Vine           DATE: 3/14/89          BY:   DFF
                     NET PLATFORM AREA =      11632
OCCUPANT LOAD CALCULATION                              DESIGN YR
-------------------------
PEAK HOUR                                     A.M.                P.M.

LINK LOADS:          INBOUND                  5469                1527
                     OUTBOUND                 2255                4477

ENTRAINING LOADS:    INBOUND                   718                 797
                     OUTBOUND                  148                 324

PEAK 15 MINUTE LOADS [=PEAK HR. LOAD x 1.15   4]
--------------------
LINK LOADS:          INBOUND                  1573                 440
                     OUTBOUND                  649                1288

ENTRAINING LOADS:    INBOUND                   207                 230
                     OUTBOUND                   43                  94

HEADWAYS:            INBOUND                   6.0                 6.0
                     OUTBOUND                  6.0                 6.0

CALCULATED TRAIN LOAD [=PEAK 15 MIN. LINK LOAD / (NO. OF HEADWAYS)]
--------------------- [NO. OF HEADWAYS =INTEGER(15 MIN. / HEADWAY)]
                                              A.M.                P.M.
                     INBOUND                   787                 220
                     OUTBOUND                  325                 644

                     TOTAL                    1112                 864
                     USE [NOT < 1320]         1320                1320

PEAK ENTRAINING LOAD =(PEAK 15 MIN. LOAD x (4 x HEADWAY / 15 MIN.))
--------------------                          A.M.                P.M.
                     INBOUND                   310                 344
                     OUTBOUND                   64                 140

                     TOTAL                     374                 484

DENSITY [=NET PLATFORM AREA / PEAK ENTRAINING LOAD]
-------                                       A.M.                P.M
          [NOT < 4 SQ.FT. / PERSON]          31.10               24.03

TOTAL OCCUPANT LOAD [=CALCULATED TRAIN LOAD + PEAK ENTRAINING LOAD]
-------------------                           A.M.                P.M.
                     TOTAL                    1694                1804
Lesser of
AREA/4 or Entraining Load + Train Load        1694                1804
TOTAL OCCUPANT LOAD FOR CALCULATIONS          1694
```

W1(waiting time at platform exits) = Occupancy Load / Exit Capacity

W1 = 1804 / 560 = 3.221 Minutes

Test 2

Evacuate Total Occupant Load from the most remote point on the platform to a point of safety in 6 minutes or less.

Walking Time for longest exit route

T = T1 + T2 + T3 + T4 + T5

	Feet	/ FPM	=	Minutes
T1 (platform)	124	200		0.620
T2 (platform to concourse)-up	16.5	50		0.330
T3 (on concourse)	261	200		1.305
T4 (concourse to grade)-up	18.5	50		0.370
T5 (grade)	0	200		0.000
			T =	2.625

Additional Waiting Time at Platform Exits

(W1 - T1)= 3.221 - 0.620 = 2.601 Minutes

Additional Waiting Time at Fare Barrier

Occupant Load at Concourse = Total Occupant Load - Emergency Stair 4 Minute Capacity

1804 - (4 x 210) = 964 Patrons

W2 = Concourse Occupant Load / Gate Capacity
W2 = 964 / 650 = 1.483 Minutes
(W2 - W1)= 1.510 - 3.221 = 0.000 Minutes

CHECK FOR UNBALANCED FLOW

Array	East	West
Patrons	663	302
Capacity	450	200
Time	1.473	1.510

Additional Waiting Time at Concourse Exits

W3 = Concourse Occupant Load / Exit Capacity
W3 = 964 / 280 = 3.443 Minutes
(W3 - W1 = 3.443 - 3.221 = 0.221 Minutes

Total Exit Time (=T+(W1-T1)+(W2-W1)+(W3-W1))

TOTAL = **5.448** MINUTES [NOT > 6 MINUTES]

```
STATION:  Hollywood/Vine          DATE: 3/14/89         BY:    DRF

EXIT LANES AND CAPACITY PROVIDED
--------------------------------

ELEMENT   DIRECTION   NUMBER   x LANES  x CAPACITY    =        PPM
                                           / LANE
Platform to Concourse
---------------------
Stairs     -up           2        3          35       =        210
           -down         0        0          40       =         0
Escalators-up            2        2          35       =        140                 scounted
           -down         0        0          40       =         0
Emer.      -up           2        3          35       =        210
Stairs     -down         0        0          40       =         0
                                                              ----
                                 16     Total                  560
Through Fare Barriers                                                     East      West
---------------------
Turnstiles              10        1          25       =        250         6         4
Fare Gates               0        1          50       =         0          0         0
Service Gates            1        2          50       =        100         1         0
Emergency Gates          3        2          50       =        300         2         1
                                                              ----
                                        Total                  650
Fare Barriers to Safe Area
--------------------------
Stairs     -up           2        3          35       =        210
           -down         0        0          40       =         0
Escalators-up *          1        2          35       =         70     * - one escalator discounted
           -down         0        0          40       =         0
Emer.      -up           0        0          35       =         0
Stairs     -down         0        0          40       =         0
                                                              ----
                                        Total                  280

                    FARE BARRIER TEST
                    -----------------
                                Array         East       West
Capacity of Fare Gates and Turnstiles          150        100     PPM
          Percent of Total Capacity          33.33      50.00    (NOT>50%)


                    EMERGENCY EXIT WIDTH TEST
                    -------------------------
Minimum Platform Exit Width
---------------------------
(=Net Platform Area /(7Sq.Ft. per Person x 50 Persons per Ft.))
Minimum Width Required =          33.24
Width Provided =                  29.33 (NOT < REQUIRED)




                    EMERGENCY EXIT CAPACITY TESTS          SHT 1 OF 3
                    -----------------------------
STATION:  Hollywood/Vine          DATE: 3/14/89         BY:    DRF
                                Test .
                                ------
```

```
                    EMERGENCY EXITING CALCULATIONS         SHT 1 OF 3

STATION: Hollywood/Highland       DATE: 3/14/89          BY:   ORF
                    NET PLATFORM AREA =      11632
OCCUPANT LOAD CALCULATION                           DESIGN YR
-------------------------
PEAK HOUR                                   A.M.                P.M.

LINK LOADS:         INBOUND                 5674                1228
                    OUTBOUND                1546                4115

ENTRAINING LOADS:   INBOUND                  884                 614
                    OUTBOUND                 263                 761

PEAK 15 MINUTE LOADS [=PEAK HR. LOAD x 1.15 / 4]
--------------------
LINK LOADS:         INBOUND                 1633                 354
                    OUTBOUND                 445                1184

ENTRAINING LOADS:   INBOUND                  255                 177
                    OUTBOUND                  76                 219

HEADWAYS:           INBOUND                  6.0                 6.0
                    OUTBOUND                 6.0                 6.0

CALCULATED TRAIN LOAD [=PEAK 15 MIN. LINK LOAD . (NO. OF HEADWAYS)]
--------------------- [NO. OF HEADWAYS =INTEGER(15 MIN. / HEADWAY)]
                                            A.M.                P.M.
                    INBOUND                  919                 177
                    OUTBOUND                 223                 592

                    TOTAL                   1042                 769
                    USE (NOT < 1320)        1320                1320

PEAK ENTRAINING LOAD =(PEAK 15 MIN. LOAD x (4 x HEADWAY / 15 MIN.)]
--------------------                        A.M.                P.M.
                    INBOUND                  381                 265
                    OUTBOUND                 114                 328

                    TOTAL                    495                 593

DENSITY [=NET PLATFORM AREA / PEAK ENTRAINING LOAD]
-------                                     A.M.                P.M.
          [NOT < 4 SQ.FT. / PERSON]        23.50               19.61

TOTAL OCCUPANT LOAD [=CALCULATED TRAIN LOAD + PEAK ENTRAINING LOAD]
-------------------                         A.M.                P.M.
                    TOTAL                   1815                1913
Lesser of
AREA/4 or Entraining Load + Train Load      1815                1913
TOTAL OCCUPANT LOAD FOR CALCULATIONS        1913
```

EMERGENCY EXIT CAPACITY

SHT 2 OF 3

STATION: Hollywood/Highland   DATE: 3/14/89   BY: DRF

EXIT LANES AND CAPACITY PROVIDED

ELEMENT	DIRECTION	NUMBER	x LANES	x CAPACITY / LANE	=	FPM	East	West	
Platform to Concourse									
Stairs	-up	2	3	35	=	210			
	-down	0	0	40	=	0			
Escalators	-up	2	2	35	=	140			scounted
	-down	0	0	40	=	0			
Emer.	-up	2	3	35	=	210			
Stairs	-down	0	0	40	=	0			
			16	Total		560			
Through Fare Barriers							*East*	*West*	
Turnstiles		10	1	25	=	250	6	4	
Fare Gates		0	1	50	=	0	0	0	
Service Gates		1	2	50	=	100	1	0	
Emergency Gates		3	2	50	=	300	2	1	
				Total		650			
Fare Barriers to Safe Area									
Stairs	-up	2	3	35	=	210			
	-down	0	0	40	=	0			
Escalators	-up *	1	2	35	=	70	* - one escalator discounted		
	-down	0	0	40	=	0			
Emer.	-up	0	0	35	=	0			
Stairs	-down	0	0	40	=	0			
				Total		280			

FARE BARRIER TEST

Array	East	West	
Capacity of Fare Gates and Turnstiles	150	100	FPM
Percent of Total Capacity	33.33	50.00	(NOT>50%)

EMERGENCY EXIT WIDTH TEST

Minimum Platform Exit Width

[=Net Platform Area /(7Sq.Ft. per Person x 50 Persons per Ft.)]

Minimum Width Required = 33.24

Width Provided = 29.33 (NOT   REQUIRED)

EMERGENCY EXIT CAPICITY TESTS

SHT 3 OF 3

STATION: Hollywood/Highland DATE: 3/14/89 BY: DRF

Test 1

Evacuate Total Occupant Load from Platform(s) in 4 minutes or less.

W1(waiting time at platform exits) = Occupancy Load / Exit Capacity

W1 = 1913 / 560 = 3.416 Minutes

Test 2

Evacuate Total Occupant Load from the most remote point on the platform to a point of safety in 6 minutes or less.

Walking Time for longest exit route

T = T1 + T2 + T3 + T4 + T5

	Feet	/ FPM	=	Minutes
T1 (platform)	124	200		0.620
T2 (platform to concourse)-up	16.5	50		0.330
T3 (on concourse)	261	200		1.305
T4 (concourse to grade)-up	18.5	50		0.370
T5 (grade)	0	200		0.000
			T =	2.625

Additional Waiting Time at Platform Exits

(W1 - T1)= 3.416 - 0.620 = 2.796 Minutes

Additional Waiting Time at Fare Barrier

Occupant Load at Concourse = Total Occupant Load - Emergency Stair 4 Minute Capacity

1913 - (4 x 210) = 1073 Patrons

W2 = Concourse Occupant Load / Gate Capacity

W2 = 1073 / 650 = 1.651 Minutes

(W2 - W1)= 1.680 - 3.416 = 0.000 Minutes

CHECK FOR UNBALANCED FLOW

Area	East	West
Patrons	735	336
Capacity	450	200
Time	1.640	1.660

Additional Waiting Time at Concourse Exits

W3 = Concourse Occupant Load / Exit Capacity

W3 = 1073 / 280 = 3.832 Minutes

(W3 - W1)= 3.832 - 3.416 = 0.416 Minutes

Total Exit Time

(=T+(W1-T1)+(W2-W1)+(W3-W1))

TOTAL = 5.837 MINUTES (NOT > 6 MINUTES)

```
                    EMERGENCY EXITING CALCULATIONS          SHT 1 OF 3

STATION:  Hollywood/Vine          DATE: 3/14/89           BY:  DRF
                    NET PLATFORM AREA =      11632
OCCUPANT LOAD CALCULATION                              DESIGN YR
-------------------------
PEAK HOUR                                  A.M.                    P.M.

LINK LOADS:         INBOUND                5469                    1527
                    OUTBOUND               2255                    4477

ENTRAINING LOADS:   INBOUND                 718                     797
                    OUTBOUND                148                     324

PEAK 15 MINUTE LOADS (=PEAK HR. LOAD x 1.15 / 4)
--------------------
LINK LOADS:         INBOUND                1573                     440
                    OUTBOUND                549                    1288

ENTRAINING LOADS:   INBOUND                 207                     230
                    OUTBOUND                 43                      94

HEADWAYS:           INBOUND                 6.0                     6.0
                    OUTBOUND                6.0                     6.0

CALCULATED TRAIN LOAD (=PEAK 15 MIN. LINK LOAD / (NO. OF HEADWAYS))
--------------------- (NO. OF HEADWAYS =INTEGER(15 MIN. / HEADWAY))
                                           A.M.                    P.M.
                    INBOUND                 787                     220
                    OUTBOUND                275                     644

                    TOTAL                  1062                     864
                    USE (NOT < 1320)       1320                    1320

PEAK ENTRAINING LOAD =(PEAK 15 MIN. LOAD x (4 x HEADWAY / 15 MIN.))
--------------------                       A.M.                    P.M.
                    INBOUND                 310                     344
                    OUTBOUND                 64                     140

                    TOTAL                   374                     484

DENSITY (=NET PLATFORM AREA / PEAK ENTRAINING LOAD)
-------                                    A.M.                    P.M.
             (NOT < 4 SQ.FT. / PERSON)    31.10                   24.03

TOTAL OCCUPANT LOAD (=CALCULATED TRAIN LOAD + PEAK ENTRAINING LOAD)
-------------------                        A.M.                    P.M.
                    TOTAL                  1694                    1804
Lesser of
AREA/4 or Entraining Load + Train Load     1694                    1804
TOTAL OCCUPANT LOAD FOR CALCULATIONS        904
```

W1(waiting time at platform exits) = Occupancy Load / Exit Capacity

W1 = 1804 / 490 = 3.682 Minutes

Test 2

Evacuate Total Occupant Load from the most remote point on the platform to a point of safety in 6 minutes or less.

Walking Time for longest exit route

T = T1 + T2 + T3 + T4 + T5

	Feet	/ FPM	=	Minutes
T1 *(platform)*	124	200		0.620
T2 (platform to concourse)-up	16.5	50		0.330
T3 (on concourse)	261	200		1.305
T4 (concourse to grade)-up	18.5	50		0.370
T5 *(grade)*	0	200		0.000
			T =	2.625

Additional Waiting Time at Platform Exits

(W1 - T1)= 3.682 - 0.620 = 3.062 Minutes

Additional Waiting Time at Fare Barrier

Occupant Load at Concourse = Total Occupant Load - Emergency Stair 4 Minute Capacity

1804 - (4 x 210) = 964 Patrons

W2 = Concourse Occupant Load / Gate Capacity
W2 = 964 / 650 = 1.483 Minutes
(W2 - W1)= 1.725 - 3.682 = 0.000 Minutes

CHECK FOR UNBALANCED FLOW

Array	East	West
Patrons	620	345
Capacity	450	200
Time	1.378	1.725

Additional Waiting Time at Concourse Exits

W3 = Concourse Occupant Load / Exit Capacity
W3 = 964 / 350 = 2.754 Minutes
(W3 - W1)= 2.754 - 3.682 = 0.000 Minutes

Total Exit Time [=T+(W1-T1)+(W2-W1)+(W3-W1)]

TOTAL = **5.687** MINUTES [NOT > 6 MINUTES]

```
                     EMERGENCY EXITING CALCULATIONS          SHT 1 OF 3

STATION:  Sunset /  Vermont        DATE: 3/17/89          BY:   DRF
                    NET PLATFORM AREA =      11632
OCCUPANT LOAD CALCULATION                              DESIGN YR
-------------------------
PEAK HOUR                                    A.M.               P.M.

LINK LOADS:         INBOUND                  6316               2112
                    OUTBOUND                 2090               4906

ENTRAINING LOADS:   INBOUND                   718                396
                    OUTBOUND                  279                287

PEAK 15 MINUTE LOADS (=PEAK HR. LOAD x 1.15 / 4)
--------------------
LINK LOADS:         INBOUND                  1816                608
                    OUTBOUND                  601               1411

ENTRAINING LOADS:   INBOUND                   207                114
                    OUTBOUND                   81                 83

HEADWAYS:           INBOUND                   6.0                6.0
                    OUTBOUND                  6.0                6.0

CALCULATED TRAIN LOAD (=PEAK 15 MIN. LINK LOAD / (NO. OF HEADWAYS))
--------------------- (NO. OF HEADWAYS =INTEGER(15 MIN. / HEADWAY))
                                             A.M.               P.M.
                    INBOUND                   908                304
                    OUTBOUND                  301                706

                    TOTAL                    1209               1010
                    USE (NOT  < 1320)        1320               1320

PEAK ENTRAINING LOAD =(PEAK 15 MIN. LOAD x (4 x HEADWAY / 15 MIN.))
--------------------                         A.M.               P.M.
                    INBOUND                   310                171
                    OUTBOUND                  121                124

                    TOTAL                     431                295

DENSITY (=NET PLATFORM AREA / PEAK ENTRAINING LOAD)
-------                                      A.M.               P.M.
          (NOT < 4 SQ.FT. / PERSON)         26.99              39.43

TOTAL OCCUPANT LOAD (=CALCULATED TRAIN LOAD + PEAK ENTRAINING LOAD)
------------------                           A.M.               P.M.
                    TOTAL                    1751               1615
Lesser of
AREA/4 or Entraining Load + Train Load       1751               1615
TOTAL OCCUPANT LOAD FOR CALCULATIONS         1751
```

```
                    EMERGENCY EXIT CAPACITY              SHT 2 OF 3
                    -----------------------
STATION:  Sunset /  Vermont       DATE: 3/17/89        BY:    DSF

EXIT LANES AND CAPACITY PROVIDED
--------------------------------

ELEMENT   DIRECTION   NUMBER   x LANES   x CAPACITY    =        PFM
                                           / LANE
Platform to Concourse
---------------------
Stairs     -up           2         3           35      =        210
           -down         0         0           40      =          0
Escalators-up *          1         2           35      =         70    * - one escalator discounted
           -down         0         0           40      =          0
Emer.      -up           2         3           35      =        210
Stairs     -down         0         0           40      =          0
                                                                ----
                                  14     Total                  490
Through Fare Barriers                                                      East      West
---------------------
Turnstiles              10         1           25      =        250         6         4
Fare Gates               0         1           50      =          0         0         0
Service Gates            1         2           50      =        100         1         0
Emergency Gates          3         2           50      =        300         2         1
                                                                ----
                                         Total                  650
Fare Barriers to Safe Area
--------------------------
Stairs     -up           2         3           35      =        210
           -down         0         0           40      =          0
Escalators-up            2         2           35      =        140
           -down         0         0           40      =          0
Emer.      -up           0         0           35      =          0
Stairs     -down         0         0           40      =          0
                                                                ----
                                         Total                  350

                    FARE BARRIER TEST
                    -----------------
                               Array        East       West
Capacity of Fare Gates and Turnstiles        150        100     PFM
         Percent of Total Capacity         33.33      50.00     (NOT>50%)


                    EMERGENCY EXIT WIDTH TEST
                    -------------------------
Minimum Platform Exit Width
---------------------------
(Level Platform Area /(7Sq.Ft. per Person x 50 Persons per Ft.))
Minimum Width Required =          33.24
Width Provided =                  25.67 (NOT > REQUIRED)
```

```
                    EMERGENCY EXIT CAPICITY TESTS          SHT 3 OF 3
                    ----------------------------
STATION:  Sunset /  Vermont       DATE: 3/17/89        BY:    DRF
                                Test 1
                                ------

Evacuate Total Occupant Load from Platform(s) in 4 minutes or less.

W1(waiting time at platform exits) = Occupancy Load / Exit Capacity

W1 =        1751    /           490    =           3.573   Minutes

                                Test 2
                                ------

Evacuate Total Occupant Load from the most remote point on the
platform to a point of safety in 6 minutes or less.

Walking Time for longest exit route
-----------------------------------
T = T1 + T2 + T3 + T4 + T5
                                    Feet      / FPM     =        Minutes
T1 (platform)                        124       200                0.620
T2 (platform to concourse)-up       16.5        50                0.330
T3 (on concourse)                    261       200                1.305
T4 (concourse to grade)-up          19.5        50                0.370
T5 (grade)                             0       200                0.000
                                                                ----------
                                                      T =         2.625

Additional Waiting Time at Platform Exits
----------------------------------------
(W1 - T1)=  3.573   -            0.620    =           2.953   Minutes

Additional Waiting Time at Fare Barrier
---------------------------------------
Occupant Load at Concourse =  Total Occupant Load - Emergency Stair 4
Minute Capacity

  1751     - (4 x       210     ) =          911     Patrons                  CHECK FOR UNBALANCED FLOW
                                                                              Array        East       West
W2 = Concourse Occupant Load / Gate Capacity                                  Patrons      585        326
W2 =          911     /          650     =          1.402   Minutes           Capacity     450        200
(W2 - W1)=  1.630    -          3.573    =          0.000   Minutes           Time        1.300      1.630

Additional Waiting Time at Concourse Exits
-----------------------------------------
W3 = Concourse Occupant Load / Exit Capacity
W3 =          911     /          350     =          2.603   Minutes
(W3 - W1)=  2.603    -          3.573    =          0.000   Minutes

Total Exit Time     (=T+(W1-T1)+(W2-W1)+(W3-W1))
---------------
TOTAL =      5.578   MINUTES   (NOT   6 MIN.TEST)
```

```
                   EMERGENCY EXITING CALCULATIONS        SHT 1 OF 3         VERBEV01.CE

STATION:  Vermont / Beverly       DATE: 3/16/89          BY:   DRF
                   NET PLATFORM AREA =     11632
OCCUPANT LOAD CALCULATION                            DESIGN YR
-------------------------
PEAK HOUR                                      A.M.               P.M.

LINK LOADS:        INBOUND                     8057               2698
                   OUTBOUND                    2217               5746

ENTRAINING LOADS:  INBOUND                      954                321
                   OUTBOUND                     300                401

PEAK 15 MINUTE LOADS [=PEAK HR. LOAD x 1.15 / 4]
--------------------
LINK LOADS:        INBOUND                     2317                775
                   OUTBOUND                     638               1652

ENTRAINING LOADS:  INBOUND                      275                 93
                   OUTBOUND                      87                116

HEADWAYS:          INBOUND                      6.0                5.0
                   OUTBOUND                     6.0                6.0

CALCULATED TRAIN LOAD [=PEAK 15 MIN. LINK LOAD / (NO. OF HEADWAYS)]
-------------------- [NO. OF HEADWAYS =INTEGER(15 MIN. / HEADWAY)]
                                               A.M.               P.M.
                   INBOUND                     1159                388
                   OUTBOUND                     319                826

                   TOTAL                       1478               1214
                   USE [NOT < 1320]            1478               1320

PEAK ENTRAINING LOAD =[PEAK 15 MIN. LOAD x (4 x HEADWAY / 15 MIN.)]
--------------------                           A.M.               P.M.
                   INBOUND                      411                139
                   OUTBOUND                     130                173

                   TOTAL                        541                312

DENSITY [=NET PLATFORM AREA / PEAK ENTRAINING LOAD]
-------                                        A.M.               P.M.
             [NOT < 4 SQ.FT. / PERSON]        21.50              37.28

TOTAL OCCUPANT LOAD [=CALCULATED TRAIN LOAD + PEAK ENTRAINING LOAD]
------------------                             A.M.               P.M.
                   TOTAL                       2019               1632
Lesser of
AREA/4 or Entraining Load + Train Load         2019               1632
TOTAL OCCUPANT LOAD FOR CALCULATIONS           2019
```

EMERGENCY EXIT CAPACITY   SHT 2 OF 3   VERBEVD1.CE

STATION: Vermont / Beverly   DATE: 3/16/89   BY: DRF

EXIT LANES AND CAPACITY PROVIDED

ELEMENT	DIRECTION	NUMBER	x LANES	x CAPACITY / LANE	=	FPM	East	West	
Platform to Concourse									
Stairs	-up	2	3	35	=	210			
	-down	0	0	40	=	0			
Escalators	-up	2	2	35	=	140			scounted
	-down	0	0	40	=	0			
Emer.	-up	2	4	35	=	280			
Stairs	-down	0	0	40	=	0			
			13	Total		630			
Through Fare Barriers							East	West	
Turnstiles		10	1	25	=	250	6	4	
Fare Gates		0	1	50	=	0	0	0	
Service Gates		1	2	50	=	100	1	0	
Emergency Gates		3	2	50	=	300	2	1	
				Total		650			
Fare Barriers to Safe Area									
Stairs	-up	2	3	35	=	210			
	-down	0	0	40	=	0			
Escalators	-up *	1	2	35	=	70			* - one escalator discounted
	-down	0	0	40	=	0			
Emer.	-up	0	0	35	=	0			
Stairs	-down	0	0	40	=	0			
				Total		280			

FARE BARRIES TEST

Array	East	West	
Capacity of Fare Gates and Turnstiles	150	100	FPM
Percent of Total Capacity	33.33	50.00	[NOT>50%]

EMERGENCY EXIT WIDTH TEST

Minimum Platform Exit Width

[=Net Platform Area /(7Sq.Ft. per Person x 50 Persons per Ft.)]

Minimum Width Required = 33.24

Width Provided = 33.60 [NOT > REQUIRED]

EMERGENCY EXIT CAPACITY TESTS   SHT 3 OF 3   VERBEV01.CE

STATION: Vermont / Beverly   DATE: 3/16/89   BY: DRF

Test 1

Evacuate Total Occupant Load from Platform(s) in 4 minutes or less.

W1(waiting time at platform exits) = Occupancy Load / Exit Capacity

W1 = 2019 / 630 = 3.205 Minutes

Test 2

Evacuate Total Occupant Load from the most remote point on the *platform to a point of safety in 6 minutes or less.*

Walking Time for longest exit route

T = T1 + T2 + T3 + T4 + T5

	Feet	/ FPM	=	Minutes
T1 (platform)	124	200		0.620
T2 (platform to concourse)-up	16.5	50		0.330
T3 (on concourse)	261	200		1.305
T4 (concourse to grade)-up	18.5	50		0.370
T5 (grade)	0	200		0.000
			T =	2.625

Additional Waiting Time at Platform Exits

(W1 - T1)= 3.205 - 0.620 = 2.585 Minutes

Additional Waiting Time at Fare Barrier

Occupant Load at Concourse = Total Occupant Load - Emergency Stair 4 Minute Capacity

2019 - (4 x 280) = 899 Patrons

W2 = Concourse Occupant Load / Gate Capacity

W2 = 899 / 650 = 1.383 Minutes

(W2 - W1)= 1.405 - 3.205 = 0.000 Minutes

CHECK FOR UNBALANCED FLOW

Array	East	West
Patrons	[illegible]	261
Capacity	451	[illegible]
Time	1.376	1.405

Additional Waiting Time at Concourse Exits

W3 = Concourse Occupant Load / Exit Capacity

W3 = 899 / 280 = 3.211 Minutes

(W3 - W1)= 3.211 - 3.205 = 0.006 Minutes

Total Exit Time (=T+(W1-T1)+(W2-W1)+(W3-W1))

TOTAL = 5.216 MINUTES (NOT > 6 MINUTES)

```
                    EMERGENCY EXITING CALCULATIONS         SHT 1 OF 3

STATION:  Vermont / Beverly       DATE: 3/14/89          BY:   DRF
                    NET PLATFORM AREA =      11632
OCCUPANT LOAD CALCULATION                            DESIGN YR
-------------------------
PEAK HOUR                                   A.M.                P.M.

LINK LOADS:         INBOUND                 8057                2679
                    OUTBOUND                2217                5746

ENTRAINING LOADS:   INBOUND                  954                 321
                    OUTBOUND                 300                 401

PEAK 15 MINUTE LOADS (=PEAK HR. LOAD x 1.15 / 4)
--------------------
LINK LOADS:         INBOUND                 2317                 776
                    OUTBOUND                 638                1652

ENTRAINING LOADS:   INBOUND                  275                  93
                    OUTBOUND                  87                 116

HEADWAYS:           INBOUND                  6.0                 6.0
                    OUTBOUND                 6.0                 6.0

CALCULATED TRAIN LOAD (=PEAK 15 MIN. LINK LOAD / (NO. OF HEADWAYS))
-------------------- (NO. OF HEADWAYS =INTEGER(15 MIN. / HEADWAY))
                                            A.M.                P.M.
                    INBOUND                 1159                 389
                    OUTBOUND                 319                 825

                    TOTAL                   1478                1214
                    USE (NOT < 1320)        1478                1320

PEAK ENTRAINING LOAD =(PEAK 15 MIN. LOAD x 4 x HEADWAY / 15 MIN.))
--------------------                        A.M.                P.M.
                    INBOUND                  411                 139
                    OUTBOUND                 130                 173

                    TOTAL                    541                 312

DENSITY (=NET PLATFORM AREA / PEAK ENTRAINING LOAD)
-------                                     A.M.                P.M.
          (NOT < 4 SQ.FT. / PERSON)        21.50               37.28

TOTAL OCCUPANT LOAD (=CALCULATED TRAIN LOAD + PEAK ENTRAINING LOAD)
-------------------                         A.M.                P.M.
                    TOTAL                   2019                1632
Lesser of
AREA/4 or Entraining Load + Train Load      2019                1632
TOTAL OCCUPANT LOAD FOR CALCULATIONS        2019
```

EMERGENCY EXIT CAPACITY

SHT 2 OF 3

STATION: Vermont / Beverly DATE: 3/14/89 BY: DRF

EXIT LANES AND CAPACITY PROVIDED

ELEMENT	DIRECTION	NUMBER	x LANES	x CAPACITY / LANE	=	FPM		
Platform to Concourse								
Stairs	-up	2	3	35	=	210		
	-down	0	0	40	=	0		
Escalators	-up *	1	2	35	=	70	* - one escalator discounted	
	-down	0	0	40	=	0		
Emer.	-up	2	3	35	=	210		
Stairs	-down	0	0	40	=	0		
			14	Total		490		
Through Fare Barriers							East	West
Turnstiles		10	1	25	=	250	6	4
Fare Gates		0	1	50	=	0	0	0
Service Gates		1	2	50	=	100	1	0
Emergency Gates		3	2	50	=	300	2	1
				Total		650		
Fare Barriers to Safe Area								
Stairs	-up	2	3	35	=	210		
	-down	0	0	40	=	0		
Escalators	-up	2	2	35	=	140		
	-down	0	0	40	=	0		
Emer.	-up	0	0	35	=	0		
Stairs	-down	0	0	40	=	0		
				Total		350		

FARE BARRIER TEST

Array	East	West	
Capacity of Fare Gates and Turnstiles	150	100	FPM
Percent of Total Capacity	33.33	50.00	[NOT>50%]

EMERGENCY EXIT WIDTH TEST

Minimum Platform Exit Width

[=Net Platform Area /(7Sq.Ft. per Person x 50 Persons per Ft.)]

Minimum Width Required = 33.24

Width Provided = 25.67 [NOT < REQUIRED]

EMERGENCY EXIT CAPICITY TESTS

SHT 3 OF 3

STATION: Vermont / Beverly DATE: 3/14/89 BY: DRF

Test 1

Evacuate Total Occupant Load from Platform(s) in 4 minutes or less.

W1(waiting time at platform exits) = Occupancy Load / Exit Capacity

W1 = 2019 / 490 = **4.120** Minutes

Test 2

Evacuate Total Occupant Load from the most remote point on the platform to a point of safety in 6 minutes or less.

Walking Time for longest exit route

T = T1 + T2 + T3 - T4 + T5

	Feet	/ FPM	=	Minutes
T1 (platform)	124	200		0.620
T2 (platform to concourse)-up	16.5	50		0.330
T3 (on concourse)	261	200		1.305
T4 (concourse to grade)-up	18.5	50		0.370
T5 (grade)	0	200		0.000
			T =	2.625

Additional Waiting Time at Platform Exits

(W1 - T1)= 4.120 - 0.620 = 3.500 Minutes

Additional Waiting Time at Fare Barrier

Occupant Load at Concourse = Total Occupant Load - Emergency Stair 4 Minute Capacity

2019 - (4 x 210) = 1179 Patrons

W2 = Concourse Occupant Load / Gate Capacity

W2 = 1179 / 650 = 1.814 Minutes

(W2 - W1)= 2.110 - 4.120 = 0.000 Minutes

CHECK FOR UNBALANCED FLOW

Array	East	West
Patrons	758	422
Capacity	450	200
Time	1.624	2.110

Additional Waiting Time at Concourse Exits

W3 = Concourse Occupant Load / Exit Capacity

W3 = 1179 / 350 = 3.369 Minutes

(W3 - W1)= 3.369 - 4.120 = 0.000 Minutes

Total Exit Time (=T+(W1-T1)+(W2-W1)+(W3-W1))

TOTAL = 6.125 MINUTES (NOT > 6 MINUTES)

```
                    EMERGENCY EXITING CALCULATIONS        SHT 1 OF 3

STATION:  Vermont / Beverly      DATE: 3/16/89          BY:   CRF
                    NET PLATFORM AREA =     11632
OCCUPANT LOAD CALCULATION                            DESIGN YR
-------------------------
PEAK HOUR                                  A.M.                P.M.

LINK LOADS:          INBOUND               8057                2698
                     OUTBOUND              2217                5746

ENTRAINING LOADS:    INBOUND                954                 321
                     OUTBOUND               300                 401

PEAK 15 MINUTE LOADS (=PEAK HR. LOAD x 1.15 / 4)
--------------------
LINK LOADS:          INBOUND               2317                 776
                     OUTBOUND               639                1652

ENTRAINING LOADS:    INBOUND                275                  93
                     OUTBOUND                87                 116

HEADWAYS:            INBOUND                6.0                 6.0
                     OUTBOUND               6.0                 6.0

CALCULATED TRAIN LOAD (=PEAK 15 MIN. LINK LOAD / (NO. OF HEADWAYS))
-------------------- (NO. OF HEADWAYS =INTEGER(15 MIN. / HEADWAY))
                                           A.M.                P.M.
                     INBOUND               1159                 388
                     OUTBOUND               319                 826

                     TOTAL                 1478                1214
                     USE (NOT < 1220)      1478                1220

PEAK ENTRAINING LOAD =(PEAK 15 MIN. LOAD x (4 x HEADWAY / 15 MIN.))
--------------------                       A.M.                P.M.
                     INBOUND                411                 139
                     OUTBOUND               130                 173

                     TOTAL                  541                 312

DENSITY (=NET PLATFORM AREA / PEAK ENTRAINING LOAD)
-------                                    A.M.                P.M.
          (NOT < 4 SQ.FT. / PERSON)       21.50               37.28

TOTAL OCCUPANT LOAD (=CALCULATED TRAIN LOAD + PEAK ENTRAINING LOAD)
-------------------                        A.M.                P.M.
                     TOTAL                 2019                1532
Lesser of
AREA/4 or Entraining Load + Train Load     2019                1632
TOTAL OCCUPANT LOAD FOR CALCULATIONS       2019
```

EMERGENCY EXIT CAPACITY

SHT 2 OF 3

STATION: Vermont / Beverly DATE: 3/16/89 BY: DSF

EXIT LANES AND CAPACITY PROVIDED

ELEMENT	DIRECTION	NUMBER	x LANES	x CAPACITY / LANE	=	PPM	East	West
Platform to Concourse								
Stairs	-up	2	3	35	=	210		
	-down	0	0	40	=	0		
Escalators	-up	2	2	35	=	140		
	-down	0	0	40	=	0		
Emer.	-up	2	3	35	=	210		
Stairs	-down	0	0	40	=	0		
			16	Total		560		
Through Fare Barriers							East	West
Turnstiles		10	1	25	=	250	6	4
Fare Gates		0	1	50	=	0	0	0
Service Gates		1	2	50	=	100	1	0
Emergency Gates		3	2	50	=	300	2	1
				Total		650		
Fare Barriers to Safe Area								
Stairs	-up	2	3	35	=	210		
	-down	0	0	40	=	0		
Escalators	-up *	1	2	35	=	70		
	-down	0	0	40	=	0		
Emer.	-up	0	0	35	=	0		
Stairs	-down	0	0	40	=	0		
				Total		280		

scounted

* - one escalator discounted

FARE BARRIER TEST

Array	East	West	
Capacity of Fare Gates and Turnstiles	150	100	PPM
Percent of Total Capacity	33.33	50.00	(NOT>50%)

EMERGENCY EXIT WIDTH TEST

Minimum Platform Exit Width

(=Net Platform Area / 7Sq.Ft. per Person x 50 Persons per Ft.))

Minimum Width Required = 33.24

Width Provided = 29.37 (NOT REQUIRED)

```
                 EMERGENCY EXIT CAPICITY TESTS          SHT 3 OF 3
                 -----------------------------
STATION:  Vermont / Beverly       DATE: 3/16/89         BY:    DRF
                            Test 1
                            ------

Evacuate Total Occupant Load from Platform(s) in 4 minutes or less.

W1(waiting time at platform exits) = Occupancy Load / Exit Capacity

W1 =         2019    /            560    =            3.605   Minutes

                            Test 2
                            ------

Evacuate Total Occupant Load from the most remote point on the
platform to a point of safety in 6 minutes or less.

Walking Time for longest exit route
-----------------------------------
T = T1 + T2 + T3 + T4 + T5
                                     Feet     / FPM    =        Minutes
T1 (platform)                         124       200              0.620
T2 (platform to concourse)-up        16.5        50              0.330
T3 (on concourse)                     261       200              1.305
T4 (concourse to grade)-up           18.5        50              0.370
T5 (grade)                              0       200              0.000
                                                               ----------
                                                       T =       2.625

Additional Waiting Time at Platform Exits
-----------------------------------------
(W1 - T1)=  3.605    -            0.620   =           2.985   Minutes

Additional Waiting Time at Fare Barrier
---------------------------------------
Occupant Load at Concourse = (Total Occupant Load - Emergency Stair 4
Minute Capacity)

 (2019    - (4 x        210     ) =           1179     Patrons                       CHECK FOR UNBALANCED FLOW
                                                                                     Array       East       West
W2 = Concourse Occupant Load / Gate Capacity                                         Patrons     [illegible]  269
W2 =          1179    /            650     =            1.814   Minutes              Capacity    450        200
(W2 - W1)=  1.345    -            3.605    =            0.000   Minutes              Time        [illegible]  1.345

Additional Waiting Time at Concourse Exits
------------------------------------------
W3 = Concourse Occupant Load / Exit Capacity
W3 =          1179    /            280     =            4.211   Minutes
(W3 - W2) =  4.211    -            3.605   =            0.605   Minutes

Total Exit Time      (=T+(W1-T1)+(W2-W1)+(W3-W2))
---------------
TOTAL =      6.215   MINUTES   (NOT < 6 MIN TEST)
```

```
                      EMERGENCY EXITING CALCULATIONS          SHT 1 OF 3

STATION:  Hollywood/Western        DATE: 3/14/89          BY:   JRF
                      NET PLATFORM AREA =      11632
OCCUPANT LOAD CALCULATION                            DESIGN YR
-------------------------
PEAK HOUR                                     A.M.                  P.M.

LINK LOADS:           INBOUND                 5786                  2167
                      OUTBOUND                2012                  4721

ENTRAINING LOADS:     INBOUND                  362                   348
                      OUTBOUND                 503                   376

PEAK 15 MINUTE LOADS [=PEAK HR. LOAD x 1.15 / 4]
--------------------
LINK LOADS:           INBOUND                 1664                   624
                      OUTBOUND                 579                  1358

ENTRAINING LOADS:     INBOUND                  248                   101
                      OUTBOUND                 145                   114

HEADWAYS:             INBOUND                  6.0                   6.0
                      OUTBOUND                 6.0                   6.0

CALCULATED TRAIN LOAD [=PEAK 15 MIN. LINK LOAD / (NO. OF HEADWAYS)]
-------------------- [NO. OF HEADWAYS =INTEGER(15 MIN. / HEADWAY)]
                                              A.M.                  P.M.
                      INBOUND                  832                   312
                      OUTBOUND                 290                   679

                      TOTAL                   1122                   991
                      USE [NOT < 1320]        1320                  1320

PEAK ENTRAINING LOAD =(PEAK 15 MIN. LOAD x (4 x HEADWAY / 15 MIN.))
--------------------                          A.M.                  P.M.
                      INBOUND                  371                   151
                      OUTBOUND                 217                   171

                      TOTAL                    588                   322

DENSITY [=NET PLATFORM AREA / PEAK ENTRAINING LOAD]
-------                                       A.M.                  P.M.
              [NOT < 4 SQ.FT. / PERSON]      19.78                 36.12

TOTAL OCCUPANT LOAD [=CALCULATED TRAIN LOAD + PEAK ENTRAINING LOAD]
-------------------                           A.M.                  P.M.
                      TOTAL                   1908                  1642
Lesser of
AREA/4 or Entraining Load + Train Load        1908                  1642
TOTAL OCCUPANT LOAD FOR CALCULATIONS          1908
```

```
                   EMERGENCY EXIT CAPACITY              SHT 2 OF 3
                   -----------------------
STATION: Hollywood/Western        DATE: 3/14/89        BY:     DRF

EXIT LANES AND CAPACITY PROVIDED
--------------------------------

ELEMENT   DIRECTION  NUMBER   x LANES  x CAPACITY    =       PPM
                                          / LANE
Platform to Concourse
---------------------
Stairs     -up          2         3          35      =       210
           -down        0         0          40      =         0
Escalators-up           2         2          35      =       140                    scounted
           -down        0         0          40      =         0
Emer.      -up          2         3          35      =       210
Stairs     -down        0         0          40      =         0
                                                            ----
                                 16   Total                  560
Through Fare Barriers                                                 East      West
---------------------
Turnstiles             10         1          25      =       250       6         4
Fare Gates              0         1          50      =         0       0         0
Service Gates           1         2          50      =       100       1         0
Emergency Gates         3         2          50      =       300       2         1
                                                            ----
                                      Total                  650
Fare Barriers to Safe Area
--------------------------
Stairs     -up          2         3          35      =       210
           -down        0         0          40      =         0
Escalators-up *         1         2          35      =        70    * - one escalator discounted
           -down        0         0          40      =         0
Emer.      -up          0         0          35      =         0
Stairs     -down        0         0          40      =         0
                                                            ----
                                      Total                  280

                   FARE BARRIER TEST
                   -----------------
                               Array       East       West
Capacity of Fare Gates and Turnstiles       150        100     PPM
         Percent of Total Capacity        33.33      50.00     [NOT>50%]


                   EMERGENCY EXIT WIDTH TEST
                   -------------------------
Minimum Platform Exit Width
---------------------------
(=Net Platform Area /(7Sq.Ft. per Person x 50 Persons per Ft.))
Minimum Width Required =          37.24
Width Provided =                  29.37 [NOT < REQUIRED]
```

EMERGENCY EXIT CAPICITY TESTS

SHT 3 OF 3

STATION: Hollywood/Western DATE: 3/14/89 BY: DRF

Test 1

Evacuate Total Occupant Load from Platform(s) in 4 minutes or less.

W1(waiting time at platform exits) = Occupancy Load / Exit Capacity

W1 = 1908 / 560 = 3.407 Minutes

Test 2

Evacuate Total Occupant Load from the most remote point on the platform to a point of safety in 6 minutes or less.

Walking Time for longest exit route

T = T1 + T2 + T3 + T4 + T5

	Feet	/ FPM	=	Minutes
T1 (platform)	124	200		0.620
T2 (platform to concourse)-up	16.5	50		0.330
T3 (on concourse)	261	200		1.305
T4 (concourse to grade)-up	18.5	50		0.370
T5 (grade)	0	200		0.000
			T =	2.625

Additional Waiting Time at Platform Exits

(W1 - T1)= 3.407 - 0.620 = 2.787 Minutes

Additional Waiting Time at Fare Barrier

Occupant Load at Concourse = Total Occupant Load - Emergency Stair 4 Minute Capacity

1908 - (4 x 210) = 1068 Patrons

W2 = Concourse Occupant Load / Gate Capacity

W2 = 1068 / 650 = 1.643 Minutes

(W2 - W1)= 1.670 - 3.407 = 0.000 Minutes

CHECK FOR UNBALANCED FLOW

Array	East	West
Patrons	735	334
Capacity	450	200
Time	1.633	1.670

Additional Waiting Time at Concourse Exits

W3 = Concourse Occupant Load / Exit Capacity

W3 = 1068 / 280 = 3.814 Minutes

(W3 - W1)= 3.814 - 3.407 = 0.407 Minutes

Total Exit Time (=T+(W1-T1)+(W2-W1)+(W3-W1))

TOTAL = 5.819 MINUTES (NOT > 6 MINUTES)

```
                    EMERGENCY EXITING CALCULATIONS         SHT 1 OF 3

STATION:  Hollywood/Western       DATE: 3/14/89          BY:   DRF
                    NET PLATFORM AREA =     11632
OCCUPANT LOAD CALCULATION                          DESIGN YR
-------------------------
PEAK HOUR                                   A.M.                P.M.

LINK LOADS:         INBOUND                 5796                2167
                    OUTBOUND                2012                4721

ENTRAINING LOADS:   INBOUND                  862                 348
                    OUTBOUND                 503                 396

PEAK 15 MINUTE LOADS [=PEAK HR. LOAD x 1.15 / 4]
--------------------
LINK LOADS:         INBOUND                 1664                 624
                    OUTBOUND                 579                1358

ENTRAINING LOADS:   INBOUND                  248                 101
                    OUTBOUND                 145                 114

HEADWAYS:           INBOUND                  6.0                 6.0
                    OUTBOUND                 6.0                 6.0

CALCULATED TRAIN LOAD [=PEAK 15 MIN. LINK LOAD / (NO. OF HEADWAYS)]
--------------------- [NO. OF HEADWAYS =INTEGER(15 MIN. / HEADWAY)]
                                            A.M.                P.M.
                    INBOUND                  832                 312
                    OUTBOUND                 290                 679

                    TOTAL                   1122                 991
                    USE [NOT < 1320]        1320                1320

PEAK ENTRAINING LOAD =(PEAK 15 MIN. LOAD x 4 x HEADWAY / 15 MIN.)]
--------------------                        A.M.                P.M.
                    INBOUND                  371                 151
                    OUTBOUND                 217                 171

                    TOTAL                    588                 322

DENSITY [=NET PLATFORM AREA / PEAK ENTRAINING LOAD]
-------                                     A.M.                P.M.
        [NOT < 4 SQ.FT. / PERSON]          19.78               36.12

TOTAL OCCUPANT LOAD [=CALCULATED TRAIN LOAD + PEAK ENTRAINING LOAD]
-------------------                         A.M.                P.M.
                    TOTAL                   1908                1642
Lesser of
AREA/4 or Entraining Load + Train Load      1908                1642
TOTAL OCCUPANT LOAD FOR CALCULATIONS        1908
```

```
                    EMERGENCY EXIT CAPACITY              SHT 2 OF 3
                    -----------------------
STATION:  Hollywood/Western        DATE: 3/14/89        BY:    CRF

EXIT LANES AND CAPACITY PROVIDED
--------------------------------

ELEMENT   DIRECTION   NUMBER   x LANES  x CAPACITY    =         PPM
                                          / LANE
Platform to Concourse
---------------------
Stairs     -up           2         3          35      =         210
           -down         0         0          40      =          0
Escalators-up *          1         2          35      =          70    * - one escalator discounted
           -down         0         0          40      =          0
Emer.      -up           2         3          35      =         210
Stairs     -down         0         0          40      =          0
                                                                ----
                                  14    Total                   490
Through Fare Barriers                                                    East      West
---------------------
Turnstiles              10         1          25      =         250        6         4
Fare Gates               0         1          50      =          0         0         0
Service Gates            1         2          50      =         100        1         0
Emergency Gates          3         2          50      =         300        2         1
                                                                ----
                                        Total                   650
Fare Barriers to Safe Area
--------------------------
Stairs     -up           2         3          35      =         210
           -down         0         0          40      =          0
Escalators-up            2         2          35      =         140
           -down         0         0          40      =          0
Emer.      -up           0         0          35      =          0
Stairs     -down         0         0          40      =          0
                                                                ----
                                        Total                   350

                    FARE BARRIER TEST
                    -----------------
                                   Array        East      West
Capacity of Fare Gates and Turnstiles           150       100     PPM
        Percent of Total Capacity               33.33     50.00   [NOT>50%]


                    EMERGENCY EXIT WIDTH TEST
                    -------------------------
Minimum Platform Exit Width
---------------------------
[=Net Platform Area /(7Sq.Ft. per Person x 50 Persons per Ft.)]
Minimum Width Required =            33.34
Width Provided =                    35.67 [NOT < REQUIRED]
```

```
                    EMERGENCY EXIT CAPICITY TESTS           SHT 3 OF 3
                    -----------------------------
 STATION:  Hollywood/Western        DATE: 3/14/89        BY:    DRF
                               Test 1
                               ------

Evacuate Total Occupant Load from Platform(s) in 4 minutes or less.

W1(waiting time at platform exits) = Occupancy Load / Exit Capacity

W1 =        1908    /            490    =           3.894   Minutes

                               Test 2
                               ------

Evacuate Total Occupant Load from the most remote point on the
platform to a point of safety in 6 minutes or less.

Walking Time for longest exit route
-----------------------------------
T = T1 + T2 + T3 + T4 + T5
                                   Feet     / FPM     =        Minutes
T1 (platform)                       124       200                0.620
T2 (platform to concourse)-up      16.5        50                0.330
T3 (on concourse)                   261       200                1.305
T4 (concourse to grade)-up         18.5        50                0.370
T5 (grade)                            0       200                0.000
                                                              ----------
                                                      T =        2.625

Additional Waiting Time at Platform Exits
-----------------------------------------
(W1 - T1)=  3.894    -            0.620    =           3.274   Minutes

Additional Waiting Time at Fare Barrier
---------------------------------------
Occupant Load at Concourse =  Total Occupant Load - Emergency Stair 4
Minute Capacity

  1908    - (4 x       210    ) =           1068    Patrons                CHECK FOR UNBALANCED FLOW
                                                                          Array         East       West
W2 = Concourse Occupant Load / Gate Capacity                               Patrons        687        382
W2 =          1068    /             650    =           1.643   Minutes     Capacity       450        200
(W2 - W1)=  1.910    -            3.894    =           0.000   Minutes     Time         1.527      1.910

Additional Waiting Time at Concourse Exits
------------------------------------------
W3 = Concourse Occupant Load / Exit Capacity
W3 =          1068    /             350    =           3.051   Minutes
(W3 - W1)=  3.051    -            3.894    =           0.000   Minutes

Total Exit Time      [=T+(W1-T1)+(W2-W1)+(W3-W1)]
---------------
TOTAL =     5.899   MINUTES   (NOT > 6 MINUTES)
```

ATTACHMENT D

SS-04307

MAY 22 1989
D.C.C.

RECEIVED BY MRTC
MAY 22 1989
SAFETY & ASSURANCE

Rolf Jensen & Associates, Inc.
FIRE PROTECTION ENGINEERS • BUILDING CODE CONSULTANTS

May 19, 1989

Mr. Malcolm Ingram
Metro Rail Transit Consultants
548 South Spring Street, 7th Floor
Los Angeles, California 90013

B331 PRE-FINAL DESIGN REVIEW

Malcolm:

This is to confirm our telephone conversation of May 19, 1989.

We have prepared hydraulic calculations for the wet standpipe system shown on the drawings. The pipe sizes shown are adequate to produce the required 500 gpm flow. A copy of the calculations is attached.

If you have any questions, please contact us.

Sincerely,

David R. Fiedler, P.E.

DRF:klr - H3275

Attachments

5229C

5252 Hollister Road • Houston, Texas 77040 • 713/462-1840 • FAX 462-0812

```
                     SPRINKLER SYSTEM HYDRAULIC ANALYSIS            Page 1
Date: May 18, 1989                                                A:\B331WSP2
JOB TITLE: H3275.01 B331 STANDPIPE
WATER SUPPLY DATA

SOURCE     STATIC     RESID.     FLOW       AVAIL.      TOTAL     REQ'D
 NODE      PRESS.     PRESS.  @             PRESS.  @  DEMAND    PRESS.
 TAG       (PSI)      (PSI)       (GPM)     (PSI)      (GPM)     (PSI)

1           69.0       20.0     2235.0      65.9       500.1      35.1


        AGGREGATE FLOW ANALYSIS:


        TOTAL FLOW AT SOURCE                                  500.1 GPM
        TOTAL HOSE STREAM ALLOWANCE AT SOURCE                   0.0 GPM
        OTHER HOSE STREAM ALLOWANCES                            0.0 GPM
        TOTAL DISCHARGE FROM ACTIVE SPRINKLERS                500.1 GPM


NODE ANALYSIS DATA

NODE TAG   ELEVATION      NODE TYPE      PRESSURE   DISCHARGE
             (FT)                          (PSI)      (GPM)

2           514.0         - - - -          65.4       - - -
3           509.0         - - - -          67.2       - - -
4           509.0         - - - -          67.1       - - -
5           506.0         - - - -          68.4       - - -
6           509.0         - - - -          67.0       - - -
7           509.0         - - - -          67.0       - - -
8           509.0         - - - -          67.1       - - -
9           506.0         - - - -          68.4       - - -
10          500.0         - - - -          70.7       - - -
11          500.0         - - - -          70.0       - - -
12          499.0         - - - -          69.8       - - -
13          503.0         - - - -          67.7       - - -
14          506.0         - - - -          66.3       - - -
15          506.0         - - - -          66.2       - - -
16          498.0         - - - -          69.3       - - -
17          497.0         - - - -          69.1       - - -
18          497.0         - - - -          68.4       - - -
18A         496.0         - - - -          68.4       - - -
18B         501.0         - - - -          66.3       - - -
19          496.0         - - - -          68.1       - - -
20          495.0         - - - -          67.9       - - -
21          495.0         - - - -          67.3       - - -
22          499.0         - - - -          65.2       - - -
23          502.0         - - - -          63.4       - - -
24          502.0         - - - -          63.4       - - -
25          494.0         - - - -          66.8       - - -
26          493.0         - - - -          66.4       - - -
27          492.0         - - - -          66.0       - - -
27A         492.0         - - - -          65.4       - - -
27B         497.0         - - - -          63.3       - - -
28          491.0         - - - -          65.5       - - -
29          490.0        K=31.00           65.0       250.0
30          490.0        K=31.00           65.0       250.0
31          495.0         - - - -          62.9       - - -
```

JOB TITLE: H3275.01 B331 STANDPIPE
NODE ANALYSIS DATA (cont'd)

NODE TAG	ELEVATION (FT)	NODE TYPE	PRESSURE (PSI)	DISCHARGE (GPM)
32	498.0	- - - -	61.7	- - -
33	498.0	- - - -	61.7	- - -
34	496.0	- - - -	62.6	- - -
35	494.0	- - - -	63.4	- - -
36	495.0	- - - -	63.0	- - -
37	497.0	- - - -	62.1	- - -
38	502.0	- - - -	60.0	- - -
39	498.0	- - - -	61.7	- - -
40	500.0	- - - -	60.8	- - -
41	502.0	- - - -	60.0	- - -
42	502.0	- - - -	60.0	- - -
43	500.0	- - - -	60.8	- - -
44	498.0	- - - -	61.7	- - -
45	497.0	- - - -	62.1	- - -
46	502.0	- - - -	60.0	- - -
47	496.0	- - - -	62.6	- - -
48	493.0	- - - -	63.9	- - -
49	491.0	- - - -	64.7	- - -
50	498.0	- - - -	61.7	- - -
51	498.0	- - - -	61.7	- - -
52	498.0	- - - -	61.7	- - -
53	495.0	- - - -	63.0	- - -
54	490.0	- - - -	65.5	- - -
55	491.0	- - - -	65.6	- - -
56	491.0	- - - -	66.1	- - -
57	492.0	- - - -	66.0	- - -
58	497.0	- - - -	63.8	- - -
59	492.0	- - - -	66.3	- - -
60	493.0	- - - -	66.4	- - -
61	494.0	- - - -	66.5	- - -
62	502.0	- - - -	63.4	- - -
63	502.0	- - - -	63.5	- - -
64	499.0	- - - -	64.8	- - -
65	495.0	- - - -	66.9	- - -
66	495.0	- - - -	67.6	- - -
67	496.0	- - - -	67.9	- - -
68	496.0	- - - -	68.3	- - -
69	501.0	- - - -	66.1	- - -
70	497.0	- - - -	68.2	- - -
71	497.0	- - - -	68.9	- - -
72	498.0	- - - -	69.2	- - -
73	506.0	- - - -	66.2	- - -
74	506.0	- - - -	66.3	- - -
75	503.0	- - - -	67.6	- - -
76	499.0	- - - -	69.7	- - -
77	500.0	- - - -	69.9	- - -
78	500.0	- - - -	70.6	- - -
1	587.0	SOURCE	35.1	500.1

```
JOB TITLE: H3275.01 B331 STANDPIPE
PIPE DATA

PIPE TAG                                  Q(GPM) DIA(IN) LENGTH     PRESS.
  END     ELEV.   NOZ.    PT   DISC. VEL(FPS) HW(C)    (FT)        SUM.
 NODES    (FT)    (K)   (PSI)  (GPM)          F.L./FT              (PSI)

     Pipe: 1                              500.1  8.071 PL 115.00  PF    1.4
1         587.0  SRCE    35.1  (N/A)    3.1     120 FTG 458.00  PE   31.6
2         514.0   0.0    65.4    0.0           0.002 TL 573.00  PV    0.0

     Pipe: 2                              500.0  6.065 PL  20.00  PF    0.3
2         514.0   0.0    65.4    0.0    5.6     120 FTG      E  PE    2.2
3         509.0   0.0    67.2    0.0           0.010 TL  34.00  PV    0.2

     Pipe: 3                              250.0  6.065 PL   4.00  PF    0.0
3         509.0   0.0    67.2    0.0    2.8     120 FTG      T  PE    0.0
4         509.0   0.0    67.1    0.0           0.003 TL  34.00  PV    0.0

     Pipe: 4                                0.0  6.065 PL   4.00  PF    0.0
4         509.0   0.0    67.1    0.0    0.0     120 FTG      T  PE    1.3
5         506.0   0.0    68.4    0.0           0.000 TL  34.00  PV    0.0

     Pipe: 5                              250.0  6.065 PL   4.00  PF    0.0
4         509.0   0.0    67.1    0.0    2.8     120 FTG      T  PE    0.0
6         509.0   0.0    67.0    0.0           0.003 TL  34.00  PV    0.0

     Pipe: 6                              250.0  6.065 PL  70.00  PF    0.2
6         509.0   0.0    67.0    0.0    2.8     120 FTG      E  PE    3.9
10        500.0   0.0    70.7    0.0           0.003 TL  84.00  PV    0.0

     Pipe: 7                                0.0  6.065 PL   8.00  PF    0.0
6         509.0   0.0    67.0    0.0    0.0     120 FTG   ----  PE    0.0
7         509.0   0.0    67.0    0.0           0.000 TL   8.00  PV    0.0

     Pipe: 8                              250.0  6.065 PL 250.00  PF    0.7
10        500.0   0.0    70.7    0.0    2.8     120 FTG   ----  PE    0.0
11        500.0   0.0    70.0    0.0           0.003 TL 250.00  PV    0.0

     Pipe: 9                              250.0  6.065 PL 250.00  PF    0.7
11        500.0   0.0    70.0    0.0    2.8     120 FTG   ----  PE    0.4
12        499.0   0.0    69.8    0.0           0.003 TL 250.00  PV    0.0

     Pipe: 10                             250.0  6.065 PL 125.00  PF    0.4
12        499.0   0.0    69.8    0.0    2.8     120 FTG      E  PE    1.7
13        503.0   0.0    67.7    0.0           0.003 TL 139.00  PV    0.0

     Pipe: 11                             250.0  6.065 PL   4.00  PF    0.0
13        503.0   0.0    67.7    0.0    2.8     120 FTG      T  PE    1.3
14        506.0   0.0    66.3    0.0           0.003 TL  34.00  PV    0.0

     Pipe: 12                             245.3  6.065 PL   4.00  PF    0.0
14        506.0   0.0    66.3    0.0    2.7     120 FTG      T  PE    0.0
15        506.0   0.0    66.2    0.0           0.003 TL  34.00  PV    0.0

     Pipe: 13                               4.7  6.065 PL   4.00  PF    0.0
14        506.0   0.0    66.3    0.0    0.0     120 FTG   ----  PE    0.0
74        506.0   0.0    66.3    0.0           0.000 TL   4.00  PV    0.0
```

```
JOB TITLE: H3275.01 B331 STANDPIPE
PIPE DATA  (cont'd)

PIPE TAG                                         Q(GPM) DIA(IN) LENGTH     PRESS.
  END      ELEV.   NOZ.    PT    DISC.  VEL(FPS) HW(C)    (FT)        SUM.
 NODES     (FT)    (K)    (PSI)  (GPM)           F.L./FT             (PSI)

     Pipe: 14                                    245.3  6.065 PL 125.00  PF    0.4
15         506.0    0.0    66.2    0.0   2.7      120 FTG       E  PE    3.5
16         498.0    0.0    69.3    0.0           0.003 TL 139.00  PV    0.0

     Pipe: 15                                    245.3  6.065 PL 250.00  PF    0.7
16         498.0    0.0    69.3    0.0   2.7      120 FTG   ----  PE    0.4
17         497.0    0.0    69.1    0.0           0.003 TL 250.00  PV    0.0

     Pipe: 16                                    245.3  6.065 PL 250.00  PF    0.7
17         497.0    0.0    69.1    0.0   2.7      120 FTG   ----  PE    0.0
18         497.0    0.0    68.4    0.0           0.003 TL 250.00  PV    0.0

     Pipe: 17                                    245.3  6.065 PL 125.00  PF    0.4
18         497.0    0.0    68.4    0.0   2.7      120 FTG      T  PE    0.4
18A        496.0    0.0    68.4    0.0           0.003 TL 155.00  PV    0.0

     Pipe: 18                                      0.0  4.026 PL    6.00  PF    0.0
18A        496.0    0.0    68.4    0.0   0.0      120 FTG   ----  PE    2.2
18B        501.0    0.0    66.3    0.0           0.000 TL    6.00  PV    0.0

     Pipe: 19                                    245.3  6.065 PL 120.00  PF    0.3
18A        496.0    0.0    68.4    0.0   2.7      120 FTG   ----  PE    0.0
19         496.0    0.0    68.1    0.0           0.003 TL 120.00  PV    0.0

     Pipe: 20                                    245.3  6.065 PL 250.00  PF    0.7
19         496.0    0.0    68.1    0.0   2.7      120 FTG   ----  PE    0.4
20         495.0    0.0    67.9    0.0           0.003 TL 250.00  PV    0.0

     Pipe: 21                                    245.3  6.065 PL 250.00  PF    0.7
20         495.0    0.0    67.9    0.0   2.7      120 FTG   ----  PE    0.0
21         495.0    0.0    67.3    0.0           0.003 TL 250.00  PV    0.0

     Pipe: 21A                                   245.3  6.065 PL 125.00  PF    0.4
21         495.0    0.0    67.3    0.0   2.7      120 FTG      E  PE    1.7
22         499.0    0.0    65.2    0.0           0.003 TL 139.00  PV    0.0

     Pipe: 22                                    245.3  6.065 PL 125.00  PF    0.4
22         499.0    0.0    65.2    0.0   2.7      120 FTG      T  PE    1.3
23         502.0    0.0    63.4    0.0           0.003 TL 155.00  PV    0.0

     Pipe: 23                                    245.3  6.065 PL    4.00  PF    0.0
23         502.0    0.0    63.4    0.0   2.7      120 FTG      T  PE    0.0
24         502.0    0.0    63.4    0.0           0.003 TL   34.00  PV    0.0

     Pipe: 24                                    -35.3  6.065 PL    8.00  PF    0.0
24         502.0    0.0    63.4    0.0   0.4      120 FTG   ----  PE    0.0
62         502.0    0.0    63.4    0.0           0.000 TL    8.00  PV    0.0

     Pipe: 25                                    280.6  6.065 PL    4.00  PF    0.0
24         502.0    0.0    63.4    0.0   3.1      120 FTG      E  PE    3.5
25         494.0    0.0    66.8    0.0           0.003 TL   18.00  PV    0.0
```

```
JOB TITLE: H3275.01 B331 STANDPIPE
PIPE DATA  (cont'd)

PIPE TAG                                    Q(GPM) DIA(IN) LENGTH      PRESS.
  END     ELEV.   NOZ.    PT    DISC. VEL(FPS) HW(C)    (FT)        SUM.
 NODES    (FT)    (K)    (PSI) (GPM)           F.L./FT              (PSI)

     Pipe: 26                               280.6  6.065 PL 250.00  PF    0.8
25        494.0   0.0    66.8    0.0   3.1     120 FTG  ----  PE    0.4
26        493.0   0.0    66.4    0.0         0.003 TL 250.00  PV    0.0

     Pipe: 27                               280.6  6.065 PL 250.00  PF    0.8
26        493.0   0.0    66.4    0.0   3.1     120 FTG  ----  PE    0.4
27        492.0   0.0    66.0    0.0         0.003 TL 250.00  PV    0.0

     Pipe: 28                               280.6  6.065 PL 125.00  PF    0.5
27        492.0   0.0    66.0    0.0   3.1     120 FTG     T  PE    0.0
27A       492.0   0.0    65.4    0.0         0.003 TL 155.00  PV    0.0

     Pipe: 29                                 0.0  4.026 PL   6.00  PF    0.0
27A       492.0   0.0    65.4    0.0   0.0     120 FTG  ----  PE    2.2
27B       497.0   0.0    63.3    0.0         0.000 TL   6.00  PV    0.0

     Pipe: 30                               280.6  6.065 PL 125.00  PF    0.4
27A       492.0   0.0    65.4    0.0   3.1     120 FTG  ----  PE    0.4
28        491.0   0.0    65.5    0.0         0.003 TL 125.00  PV    0.0

     Pipe: 31                               280.6  6.065 PL 250.00  PF    0.8
28        491.0   0.0    65.5    0.0   3.1     120 FTG  ----  PE    0.4
29        490.0  31.0    65.0  250.0         0.003 TL 250.00  PV    0.0

     Pipe: 32                                30.6  6.065 PL 250.00  PF    0.0
29        490.0  31.0    65.0  250.0   0.3     120 FTG  ----  PE    0.0
30        490.0  31.0    65.0  250.0         0.000 TL 250.00  PV    0.0

     Pipe: 33                              -219.4  6.065 PL   4.00  PF    0.0
30        490.0  31.0    65.0  250.0   2.4     120 FTG     E  PE    2.2
31        495.0   0.0    62.9    0.0         0.002 TL  18.00  PV    0.0

     Pipe: 34                              -219.4  6.065 PL   4.00  PF    0.0
31        495.0   0.0    62.9    0.0   2.4     120 FTG     T  PE    1.3
32        498.0   0.0    61.7    0.0         0.002 TL  34.00  PV    0.0

     Pipe: 35                               -87.6  6.065 PL   4.00  PF    0.0
32        498.0   0.0    61.7    0.0   1.0     120 FTG     T  PE    0.0
33        498.0   0.0    61.7    0.0         0.000 TL  34.00  PV    0.0

     Pipe: 36                                -3.6  6.065 PL 125.00  PF    0.0
33        498.0   0.0    61.7    0.0   0.0     120 FTG     E  PE    0.9
34        496.0   0.0    62.6    0.0         0.000 TL 139.00  PV    0.0

     Pipe: 37                               -86.1  6.065 PL   8.00  PF    0.0
33        498.0   0.0    61.7    0.0   1.0     120 FTG  ----  PE    0.0
50        498.0   0.0    61.7    0.0         0.000 TL   8.00  PV    0.0

     Pipe: 38                                -3.6  6.065 PL 125.00  PF    0.0
34        496.0   0.0    62.6    0.0   0.0     120 FTG  ----  PE    0.9
35        494.0   0.0    63.4    0.0         0.000 TL 125.00  PV    0.0
```

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JOB TITLE: H3275.01 B331 STANDPIPE
PIPE DATA  (cont'd)

PIPE TAG                                      Q(GPM) DIA(IN) LENGTH     PRESS.
  END      ELEV.    NOZ.     PT    DISC.  VEL(FPS) HW(C)    (FT)       SUM.
 NODES     (FT)     (K)     (PSI)  (GPM)           F.L./FT             (PSI)

     Pipe: 39                                  -3.6   6.065 PL 250.00  PF    0.0
35         494.0    0.0     63.4     0.0    0.0     120 FTG  ----   PE    0.4
36         495.0    0.0     63.0     0.0           0.000 TL 250.00  PV    0.0

     Pipe: 40                                  -3.6   6.065 PL 125.00  PF    0.0
36         495.0    0.0     63.0     0.0    0.0     120 FTG     T   PE    0.9
37         497.0    0.0     62.1     0.0           0.000 TL 155.00  PV    0.0

     Pipe: 41                                   0.0   4.026 PL   6.00  PF    0.0
37         497.0    0.0     62.1     0.0    0.0     120 FTG  ----   PE    2.2
38         502.0    0.0     60.0     0.0           0.000 TL   6.00  PV    0.0

     Pipe: 42                                  -3.6   6.065 PL 125.00  PF    0.0
37         497.0    0.0     62.1     0.0    0.0     120 FTG  ----   PE    0.4
39         498.0    0.0     61.7     0.0           0.000 TL 125.00  PV    0.0

     Pipe: 43                                  -3.6   6.065 PL 250.00  PF    0.0
39         498.0    0.0     61.7     0.0    0.0     120 FTG  ----   PE    0.9
40         500.0    0.0     60.8     0.0           0.000 TL 250.00  PV    0.0

     Pipe: 44                                  -3.6   6.065 PL 250.00  PF    0.0
40         500.0    0.0     60.8     0.0    0.0     120 FTG  ----   PE    0.9
41         502.0    0.0     60.0     0.0           0.000 TL 250.00  PV    0.0

     Pipe: 45                                  -3.6   6.065 PL 250.00  PF    0.0
41         502.0    0.0     60.0     0.0    0.0     120 FTG    2E   PE    0.0
42         502.0    0.0     60.0     0.0           0.000 TL 278.00  PV    0.0

     Pipe: 46                                  -3.6   6.065 PL 250.00  PF    0.0
42         502.0    0.0     60.0     0.0    0.0     120 FTG  ----   PE    0.9
43         500.0    0.0     60.8     0.0           0.000 TL 250.00  PV    0.0

     Pipe: 47                                  -3.6   6.065 PL 250.00  PF    0.0
43         500.0    0.0     60.8     0.0    0.0     120 FTG  ----   PE    0.9
44         498.0    0.0     61.7     0.0           0.000 TL 250.00  PV    0.0

     Pipe: 48                                  -3.6   6.065 PL 125.00  PF    0.0
44         498.0    0.0     61.7     0.0    0.0     120 FTG     T   PE    0.4
45         497.0    0.0     62.1     0.0           0.000 TL 155.00  PV    0.0

     Pipe: 49                                   0.0   4.026 PL   6.00  PF    0.0
45         497.0    0.0     62.1     0.0    0.0     120 FTG  ----   PE    2.2
46         502.0    0.0     60.0     0.0           0.000 TL   6.00  PV    0.0

     Pipe: 50                                  -3.6   6.065 PL 125.00  PF    0.0
45         497.0    0.0     62.1     0.0    0.0     120 FTG  ----   PE    0.4
47         496.0    0.0     62.6     0.0           0.000 TL 125.00  PV    0.0

     Pipe: 51                                  -3.6   6.065 PL 250.00  PF    0.0
47         496.0    0.0     62.6     0.0    0.0     120 FTG  ----   PE    1.3
48         493.0    0.0     63.9     0.0           0.000 TL 250.00  PV    0.0
```

```
JOB TITLE: H3275.01 B331 STANDPIPE
PIPE DATA  (cont'd)

PIPE TAG                                      Q(GPM)  DIA(IN) LENGTH     PRESS.
  END      ELEV.   NOZ.    PT   DISC.  VEL(FPS) HW(C)    (FT)        SUM.
 NODES     (FT)    (K)   (PSI) (GPM)           F.L./FT               (PSI)

     Pipe: 52                                   -3.6   6.065 PL 125.00  PF    0.0
48        493.0   0.0   63.9    0.0     0.0    120 FTG ----  PE    0.9
49        491.0   0.0   64.7    0.0            0.000 TL 125.00  PV    0.0

     Pipe: 53                                   -3.6   6.065 PL 125.00  PF    0.0
49        491.0   0.0   64.7    0.0     0.0    120 FTG    ET  FE    3.0
50        498.0   0.0   61.7    0.0            0.000 TL 169.00  PV    0.0

     Pipe: 54                                  -89.6   6.065 PL   4.00  PF    0.0
50        498.0   0.0   61.7    0.0     1.0    120 FTG     T  PE    0.0
51        498.0   0.0   61.7    0.0            0.000 TL  34.00  PV    0.0

     Pipe: 55                                 -129.8   6.065 PL   4.00  PF  . 0.0
50        498.0   0.0   61.7    0.0     1.4    120 FTG     T  PE    0.0
52        498.0   0.0   61.7    0.0            0.000 TL  34.00  PV    0.0

     Pipe: 56                                 -129.8   6.065 PL   4.00  PF    0.0
52        498.0   0.0   61.7    0.0     1.4    120 FTG ----  PE    0.0
51        498.0   0.0   61.7    0.0            0.000 TL   4.00  PV    0.0

     Pipe: 57                                 -219.4   6.065 PL   4.00  PF    0.0
51        498.0   0.0   61.7    0.0     2.4    120 FTG ----  PE    1.3
53        495.0   0.0   63.0    0.0            0.002 TL   4.00  PV    0.0

     Pipe: 58                                 -219.4   6.065 PL 125.00  PF    0.3
53        495.0   0.0   63.0    0.0     2.4    120 FTG     E  PE    2.2
54        490.0   0.0   65.5    0.0            0.002 TL 139.00  PV    0.0

     Pipe: 59                                 -219.4   6.065 PL 250.00  PF    0.5
54        490.0   0.0   65.5    0.0     2.4    120 FTG -----  PE    0.4
55        491.0   0.0   65.6    0.0            0.002 TL 250.00  PV    0.0

     Pipe: 60                                 -219.4   6.065 PL 250.00  PF    0.5
55        491.0   0.0   65.6    0.0     2.4    120 FTG ----  PE    0.0
56        491.0   0.0   66.1    0.0            0.002 TL 250.00  PV    0.0

     Pipe: 61                                 -219.4   6.065 PL 125.00  PF    0.3
56        491.0   0.0   66.1    0.0     2.4    120 FTG     T  PE    0.4
57        492.0   0.0   66.0    0.0            0.002 TL 155.00  PV    0.0

     Pipe: 62                                    0.0   4.026 PL   6.00  PF    0.0
57        492.0   0.0   66.0    0.0     0.0    120 FTG ----  PE    2.2
58        497.0   0.0   63.8    0.0            0.000 TL   6.00  PV    0.0

     Pipe: 63                                 -219.4   6.065 PL 125.00  PF    0.3
57        492.0   0.0   66.0    0.0     2.4    120 FTG ----  PE    0.0
59        492.0   0.0   66.3    0.0            0.002 TL 125.00  PV    0.0

     Pipe: 64                                 -219.4   6.065 PL 250.00  PF    0.5
59        492.0   0.0   66.3    0.0     2.4    120 FTG ----  PE    0.4
60        493.0   0.0   66.4    0.0            0.002 TL 250.00  PV    0.0
```

```
JOB TITLE: H3275.01 B331 STANDPIPE
PIPE DATA  (cont'd)

PIPE TAG                                     Q(GPM) DIA(IN) LENGTH     PRESS.
  END      ELEV.   NOZ.    PT   DISC.  VEL(FPS) HW(C)    (FT)        SUM.
 NODES     (FT)    (K)   (PSI) (GPM)          F.L./FT                (PSI)

     Pipe: 65                                -219.4  6.065 PL 250.00  PF    0.5
60         493.0   0.0    66.4    0.0   2.4     120 FTG  ----   PE    0.4
61         494.0   0.0    66.5    0.0          0.002 TL 250.00  PV    0.0

     Pipe: 66                                -219.4  6.065 PL 125.00  PF    0.4
61         494.0   0.0    66.5    0.0   2.4     120 FTG     ET  PE    3.5
62         502.0   0.0    63.4    0.0          0.002 TL 169.00  PV    0.0

     Pipe: 67                                -254.8  6.065 PL   4.00  PF    0.0
62         502.0   0.0    63.4    0.0   2.8     120 FTG      T  PE    0.0
63         502.0   0.0    63.5    0.0          0.003 TL  34.00  PV    0.0

     Pipe: 68                                -254.8  6.065 PL   4.00  PF    0.0
63         502.0   0.0    63.5    0.0   2.8     120 FTG   ----  PE    1.3
64         499.0   0.0    64.8    0.0          0.003 TL   4.00  PV    0.0

     Pipe: 69                                -254.8  6.065 PL 125.00  PF    0.4
64         499.0   0.0    64.8    0.0   2.8     120 FTG      E  PE    1.7
65         495.0   0.0    66.9    0.0          0.003 TL 139.00  PV    0.0

     Pipe: 70                                -254.8  6.065 PL 250.00  PF    0.7
65         495.0   0.0    66.9    0.0   2.8     120 FTG   ----  PE    0.0
66         495.0   0.0    67.6    0.0          0.003 TL 250.00  PV    0.0

     Pipe: 71                                -254.8  6.065 PL 250.00  PF    0.7
66         495.0   0.0    67.6    0.0   2.8     120 FTG   ----  PE    0.4
67         496.0   0.0    67.9    0.0          0.003 TL 250.00  PV    0.0

     Pipe: 72                                -254.8  6.065 PL 120.00  PF    0.4
67         496.0   0.0    67.9    0.0   2.8     120 FTG      T  PE    0.0
68         496.0   0.0    68.3    0.0          0.003 TL 150.00  PV    0.0

     Pipe: 73                                   0.0  4.026 PL   6.00  PF    0.0
68         496.0   0.0    68.3    0.0   0.0     120 FTG   ----  PE    2.2
69         501.0   0.0    66.1    0.0          0.000 TL   6.00  PV    0.0

     Pipe: 74                                -254.8  6.065 PL 125.00  PF    0.4
68         496.0   0.0    68.3    0.0   2.8     120 FTG   ----  PE    0.4
70         497.0   0.0    68.2    0.0          0.003 TL 125.00  PV    0.0

     Pipe: 75                                -254.8  6.065 PL 250.00  PF    0.7
70         497.0   0.0    68.2    0.0   2.8     120 FTG   ----  PE    0.0
71         497.0   0.0    68.9    0.0          0.003 TL 250.00  PV    0.0

     Pipe: 76                                -254.8  6.065 PL 250.00  PF    0.7
71         497.0   0.0    68.9    0.0   2.8     120 FTG   ----  PE    0.4
72         498.0   0.0    69.2    0.0          0.003 TL 250.00  PV    0.0

     Pipe: 77                                -254.8  6.065 PL 125.00  PF    0.5
72         498.0   0.0    69.2    0.0   2.8     120 FTG     ET  PE    3.5
73         506.0   0.0    66.2    0.0          0.003 TL 169.00  PV    0.0
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JOB TITLE: H3275.01 B331 STANDPIPE
PIPE DATA  (cont'd)

PIPE TAG                                         Q(GPM) DIA(IN) LENGTH     PRESS.
  END      ELEV.   NOZ.     PT    DISC.  VEL(FPS) HW(C)    (FT)          SUM.
 NODES     (FT)    (K)    (PSI)  (GPM)            F.L./FT                (PSI)

     Pipe: 78                                    -254.8  6.065 PL    4.00  PF     0.0
73         506.0   0.0    66.2      0.0    2.8     120 FTG      T  PE     0.0
74         506.0   0.0    66.3      0.0            0.003 TL   34.00  PV     0.0

     Pipe: 79                                    -250.0  6.065 PL    4.00  PF     0.0
74         506.0   0.0    66.3      0.0    2.8     120 FTG   ----  PE     1.3
75         503.0   0.0    67.6      0.0            0.003 TL    4.00  PV     0.0

     Pipe: 80                                    -250.0  6.065 PL  125.00  PF     0.4
75         503.0   0.0    67.6      0.0    2.8     120 FTG      E  PE     1.7
76         499.0   0.0    69.7      0.0            0.003 TL  139.00  PV     0.0

     Pipe: 81                                    -250.0  6.065 PL  250.00  PF     0.7
76         499.0   0.0    69.7      0.0    2.8     120 FTG   ----  FE     0.4
77         500.0   0.0    69.9      0.0            0.003 TL  250.00  PV     0.0

     Pipe: 82                                    -250.0  6.065 PL  250.00  PF     0.7
77         500.0   0.0    69.9      0.0    2.8     120 FTG   ----  PE     0.0
78         500.0   0.0    70.6      0.0            0.003 TL  250.00  PV     0.0

     Pipe: 83                                    -250.0  6.065 PL   70.00  PF     0.3
78         500.0   0.0    70.6      0.0    2.8     120 FTG     ET  PE     3.9
7          509.0   0.0    67.0      0.0            0.003 TL  114.00  PV     0.0

     Pipe: 84                                    -250.0  6.065 PL    4.00  PF     0.0
7          509.0   0.0    67.0      0.0    2.8     120 FTG      T  PE     0.0
8          509.0   0.0    67.1      0.0            0.003 TL   34.00  PV     0.0

     Pipe: 85                                    -250.0  6.065 PL    4.00  PF     0.0
8          509.0   0.0    67.1      0.0    2.8     120 FTG      T  PE     0.0
3          509.0   0.0    67.2      0.0            0.003 TL   34.00  PV     0.0

     Pipe: 86                                       0.0  6.065 PL    4.00  PF     0.0
8          509.0   0.0    67.1      0.0    0.0     120 FTG  -----  PE     1.3
9          506.0   0.0    68.4      0.0            0.000 TL    4.00  PV     0.0

NOTES:
 (1) Calculations were performed by the HASS 5.2.1 computer program
     under license no. 3146 75A   granted by
                        HRS Systems, Inc.
                        2193 Ranchwood Dr., N.E.
                        Atlanta, GA  30345

 (2) The system has been balanced to provide an average
     imbalance at each node of  0.007 gpm and a maximum
     imbalance at any node of  0.231 gpm.

 (3) Velocity pressures are printed for information only, and are
     not used in balancing the system.  Maximum water velocity in
     any pipe is   5.6 ft/sec.
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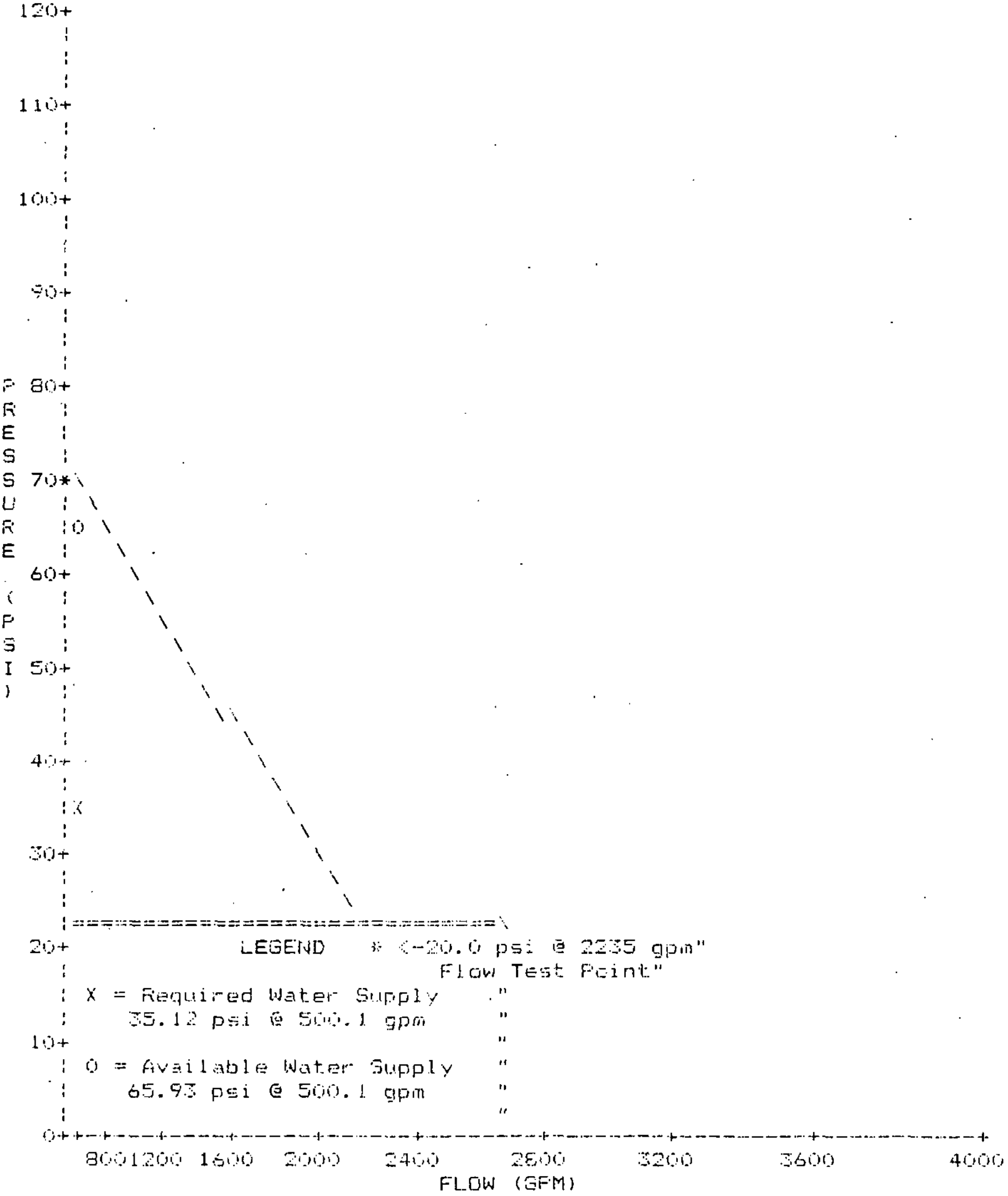
JOB TITLE: H3275.01 B331 STANDPIPE

PIPE FITTINGS TABLE

Nominal Diameter (in)	Equivalent Fitting Lengths in Feet (C=120) E	T	L	C	B	G	A	D
1.00	2.00	5.00	2.00	5.00	6.00	1.00	10.00	10.00
1.25	3.00	6.00	2.00	7.00	6.00	1.00	10.00	10.00
1.50	4.00	8.00	2.00	9.00	6.00	1.00	10.00	10.00
2.00	5.00	10.00	3.00	11.00	6.00	1.00	10.00	10.00
2.50	6.00	12.00	4.00	14.00	7.00	1.00	10.00	10.00
3.00	7.00	15.00	5.00	16.00	10.00	1.00	13.00	10.00
3.50	8.00	17.00	5.00	19.00	11.00	1.00	14.00	10.00
4.00	10.00	20.00	6.00	22.00	12.00	2.00	20.00	10.00
5.00	12.00	25.00	8.00	27.00	9.00	2.00	21.00	15.00
6.00	14.00	30.00	9.00	32.00	10.00	3.00	28.00	19.00
8.00	18.00	35.00	13.00	45.00	12.00	4.00	35.00	27.00
10.00	22.00	50.00	16.00	55.00	19.00	5.00	40.00	29.00
12.00	27.00	60.00	18.00	65.00	21.00	6.00	49.00	35.00
16.00	35.00	70.00	28.00	86.00	22.00	7.00	63.00	45.00
18.00	39.00	85.00	33.00	98.00	39.00	8.00	70.00	50.00

Fitting Code Letters: E=standard ell T=tee L=long turn ell
C=check valve B=butterfly valve G=gate valve
A=alarm check valve D=dry pipe valve

JOB TITLE: H3275.01 B331 STANDPIPE
WATER SUPPLY CURVE



FIRE SERVICE "PRESSURE-FLOW" REPORT

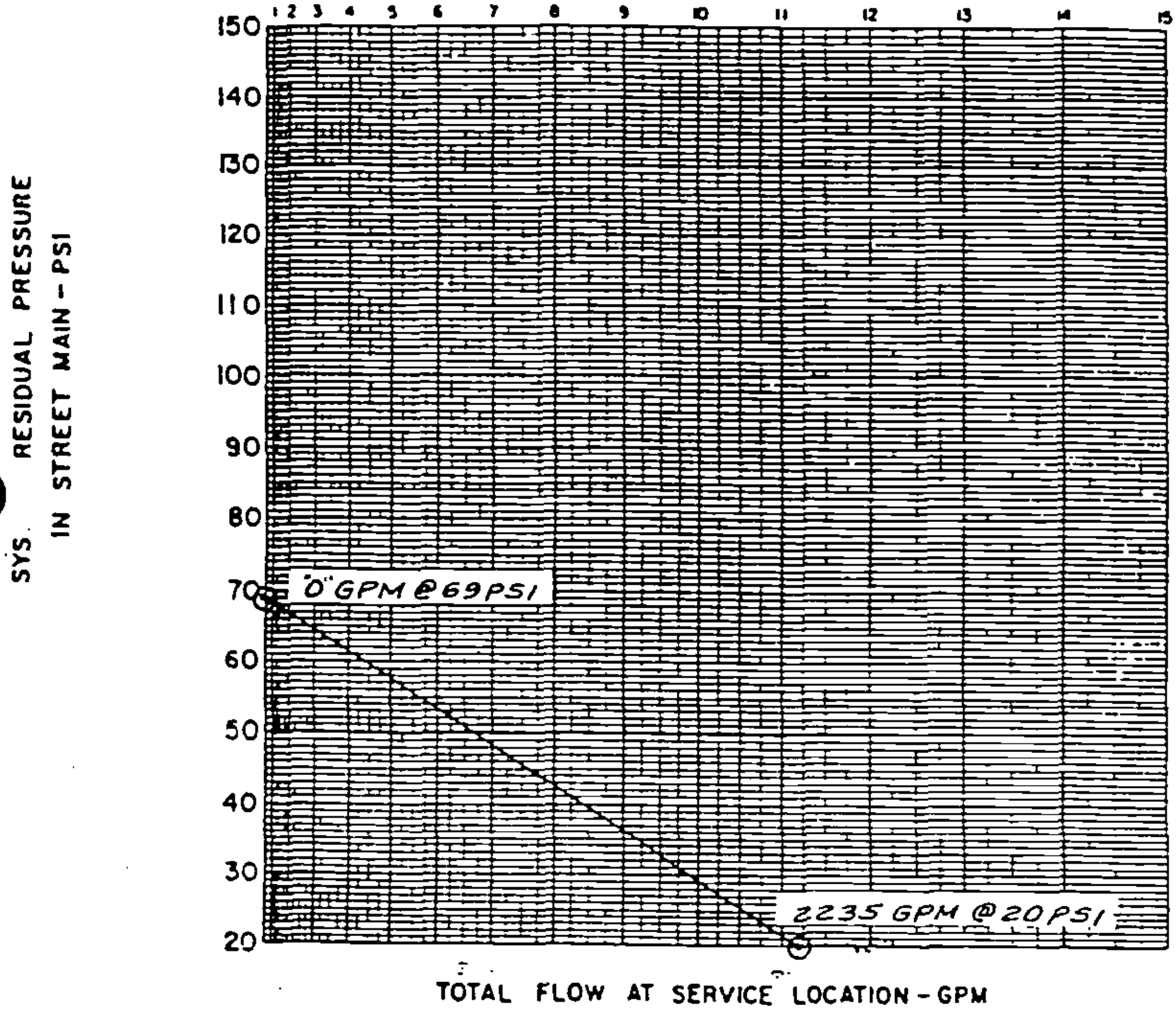
Address F.H. @ SE/COR. LANKERSHIM BL. & RIVERSIDE DR.

Location of (proposed/existing) ______ inch Fire Service and (proposed/existing) ______ inch Domestic Service off the ______ inch main in ______________________ ______ side approximately ______ feet ______ of ______________.

The system maximum pressure is 118 psi based on a street elevation of 587 feet at the service location. This system maximum pressure should be used in determining the class of piping and fittings only.

The flow quantities and pressures delineated by the graph below are determined to be available at the requested service location. Future conditions in the system, however, may cause the flow quantities and pressures to change accordingly.

MULTIPLY SCALE BY 200



DOMESTIC METER	FLOW** (GPM)
1"	56
1-1/2"	96
2"	160
3"	220
4"	400
6"	700*
8"	1500
10"	2500

FIRE SERVICE	FLOW** (GPM)
2"	250
4"	600
6"	1400
8"	2500
10"	5000

F.M. SERVICE	FLOW** (GPM)
8"	2500
10"	5000

* 1000 GPM MAY BE USED WHEN COMBINATION STANDPIPE IS INSTALLED

** MAXIMUM PERMISSIBLE FLOW FOR SIZE SHOWN

This graph will be submitted to the Department of Building and Safety for plan check purposes. For additional information call

WATER OPERATING DIVISION
Distribution Engineering - Rm. 1432 GOB

. Valley 481-3273 ☐
. Valley 481-4089 ☒
Harbor 481-6205 ☐
Western 481-3272 ☐
Central 481-6086 ☐

Prepared by	Checked by	Approved by
MIRA SIMON APR 1 1989	M. J. ALDRIAN APR 14 1989	ELDON HORST APR 14 1989

Coord. 166-174

P.M. ______________

Form Rev. — 2/86